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ABSTRACT

This monograph has been designed to provide a detailed explanation of the organization and philosophy of the Ohio Sea Grant Program and the rationale used in each of its elements. Information is presented in six sections and nine appendices. Establishment of education program priorities and initial efforts are discussed in the introduction. Identification of Oceanic Education Activities for Great Lakes School (OEAGLS) topics, creation of activities, and evaluation methods are discussed in the second section (development process). Dissemination programs are considered in the third section, focusing on activities during the development process, infusion program, awareness component, implementation component, and future directions for teacher education. Summative evaluation of OEAGLS and infusion programs are discussed in the fourth section. Efforts in higher education and nonformal education efforts (radio, museum programming, television) are briefly reviewed in the last two sections. Information provided in appendices includes: sample pretest used in OEAGLS development; teacher evaluation forms for OEAGLS pilot testing; "Water Education Curriculum" (description of OEAGLS evaluation); Middle Sea newsletter; OEAGLS catalog; paper on marine and aquatic education (includes resource materials lists); implementation workshop syllabus/evaluation forms; and a research study (Ohio Students' Knowledge and Attitudes about the Oceans and Great Lakes). (JN)

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THE
OHIO SEA GRANT EDUCATION PROGRAM

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
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by

Victor J. Mayer and Rosanne W. Fortner

The Ohio State University

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THE OHIO SEA GRANT EDUCATION PROGRAM

by

Victor J. Mayer

and

Rosanne W. Fortner

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TABLE OF CONTENTS

Topic Page

Introduction 1
  Establishment of Education Program Priorities 2
  Initiation of Efforts 2

The Development Process. 5

  Advisory Committee. 5
  Identification of Topics. 5
  Creation of Activities. 5
  Evaluation. 6

Dissemination Programs 8

  Activities During Development Process 8
  Infusion Program. 9
  Awareness Component 10
  Implementation Component. .16
  Future Directions for Teacher Education 18

Summative Evaluation of OEAGLS and Infusion Programs 19

  Questions to be Answered. .19
  Description of Research 19
  Implications for Ohio Sea Grant Education Programs. 22

Efforts in Higher Education. .23
Nonformal Education Efforts. .24

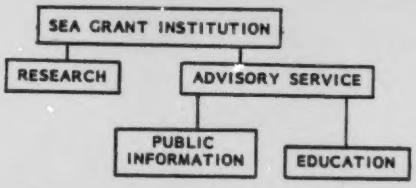
  Radio 24
  Museum Programming. 24
  Television. 25

Introduction

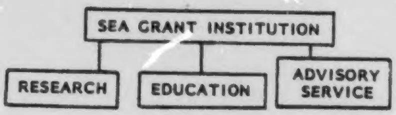
In 1975, the Columbus Council of the Navy League of the United States provided a grant to the Ohio State University in support of a state survey to determine the level of understanding of marine information among the public school children of Ohio. In addition it supported a summer workshop in the Humanities of the Seas conducted for teachers in Ohio schools. Thirty teachers participated from all over the state. These events marked the beginning of the program in Marine and Aquatic Education now conducted through Ohio Sea Grant. They in turn led to the development of the Ohio Sea Grant Education Program. In the process of its development, a particular organization and philosophy has been implemented that may be of interest as a model for other Sea Grant Education programs and indeed for other programs seeking to improve education in any area of concern. This monograph has been designed to provide a detailed explanation of the organization and philosophy of the program and the rationale used in each of its elements.

Although there has been some attention to curriculum development and teacher training over the past five years, funding for Sea Grant education programs has most often focused on higher education and vocational education. In fact there seems to be a return to this focus with the recent national level emphasis upon fisheries education, all of which is appropriately conducted in vocational educational institutions and institutions of higher education. Few Sea Grant organizations have targeted education as a priority area for development. Seldom are educators with training and experience at the elementary and secondary school levels, in teacher education and curriculum development, and also in nonformal public education involved in program development and supervision. These factors have led by and large to a lack of program philosophy and direction in Sea Grant education programs. In many cases this results in poorly coordinated efforts which lead to duplication and the failure to institutionalize programs. As a result programs disappear after Sea Grant funding is terminated. Although there have been some exceptional efforts in education that are having and will continue to have an effect upon elementary, secondary and higher education in certain states, with proper program organization and emphasis there could be many more effective programs. We hope that this monograph will provide some insight into such effective program formats and thereby help to improve Sea Grant education programs in the future.

Part of the uniqueness of the Ohio Sea Grant Education program may lie in the fact that it was the first component funded in Ohio Sea Grant and led to the development of the other two components: Advisory Service and Research. This has given the education program a certain standing within the Sea Grant program office locally and nationally and therefore a stronger voice in policy and funding decisions. This is further institutionalized by the fact that education has been established as a separate program on equal standing with advisory service and research (see Figure 1). The education coordinator is a member of the four person executive



A. Education functions housed within advisory service



B. Separate and equal component (as in Ohio)

FIGURE 1

Placement of Education Components in Two Different Models of Sea Grant Organization committee of Ohio Sea Grant and therefore shares in the responsibility for developing and implementing overall program policies. Even this would not ensure the effective organization of the education program except for the fact that a trained and respected science educator, Dr. Victor J. Mayer, has functioned as the education coordinator. His experience along with the perspective and background of Dr. Rosanne W. Fortner, a co-principal investigator trained in marine and aquatic education, has provided a basis in experience and creativity that has produced programs attuned to the needs and organization of Ohio schools and adaptive to opportunities in nonformal educational institutions and the mass media. For formal education, close relationships have been established between the education program office, the Ohio Department of Education, the Environmental Education Office of the Ohio Department of Natural Resources and local school systems. In addition communication has been established with other Sea Grant educators in the Great Lakes Region. Only the lack of funding has prohibited the further development of productive channels of cooperation through a Great Lakes Education Network. Nonformal thrusts have introduced educational ventures with central Ohio radio stations, interactive cable television (Warner QUBE), the Cousteau Society and Columbus' Center of Science and Industry. Expansion of these relationships promises opportunity for additional public education activities.

ESTABLISHMENT OF EDUCATION PROGRAM PRIORITIES

In establishing program priorities a basic question was asked to guide priority identification. With limited resources, what type of education program would have the greatest impact on the largest number of Ohio citizens? The institutions with the most prolonged contact with the largest number of families in any state are the pre-college schools. Through them an effective program would not only contact the students, but the adults in their families as well. A program focused on the schools would also impact every county in the state and not be restricted to those served by advisory service offices which are located only along the Lake Erie coast. Once schools are adequately served with appropriate marine and aquatic education programs a base of support will have been established for movement into other levels and kinds of education. Following the rationale of serving the largest citizenry possible with initial efforts, the program could move on to informal education institutions such as museums and explore uses of the mass media for public awareness.

While these first-served organizations can function to build aquatic awareness among Ohio citizens as a priority within Sea Grant, it was not forgotten that there also needed to be a career component to the program. What needs exist for training programs focused on careers in marine science for Ohio citizens? This was a difficult question to answer, and one which still has not been resolved. This was clearly a second order priority, however. In other Sea Grant programs by contrast career training was and is the major focus of Sea Grant Education efforts. Because of Ohio's inland location, the strength of existing limnology and fishery programs in higher education and the availability of marine career programs at other Sea Grant institutions, the major focus of Ohio Sea Grant was and probably will remain on aquatic awareness programs.

INITIATION OF EFFORTS

With the schools identified as the first priority for a Sea Grant education program, the next question was how to effectively incorporate information of interest to Sea Grant into school curricula. Work with the Humanities of the Seas programs in 1976 through 1978 revealed few curriculum materials available for teaching marine and aquatic concepts in inland schools. These Humanities programs were teacher education workshops. Without teaching materials to present to the teachers, however, the effectiveness of the workshops, as indicated by the inclusion of new concepts into the curriculum, was minimal. Experience with these and other programs indicated that teachers simply do not have the time, nor in many cases the ability, to develop their own teaching materials in fields that are new to them. Therefore it was felt that the first step in a broad awareness program for Ohio was to develop teaching materials that could be used in the state. The OEAGLS project (Oceanic Education Activities for Great Lakes Schools) was initiated with Sea Grant funding in 1977 as the first project of Ohio Sea Grant.

Decisions were made on the grade level and format for the materials based on information generated through studies sponsored by the National Science Foundation (NSF) and from experience with previous curriculum development efforts, such as the Crustal Evolution Education Project (CEEP), a program conducted through the National Association of Geology Teachers (Mayer and Stoever, 1978) for developing supplemental curriculum materials for earth science classes. Studies indicated a dramatic drop-off of interest in science among children, especially among girls and minorities, during the middle school years. This decline in interest was of concern for the directorate of the NSF. As a result, most of their later education efforts were directed at improving teaching materials and teacher backgrounds at the middle school level. The OEAGLS project was likewise focused on grades 5 through 9 to assist Ohio schools in improving curricula used during those critical years.

Since marine and aquatic education is interdisciplinary in nature, involving content from a variety of scientific fields, the humanities and the social sciences, its successful implementation into the school curriculum needed to take that into account. In the middle school years students are becoming old enough to handle more sophisticated information, yet most school programs are organized in such a way that teachers can easily teach in an interdisciplinary format. For example, many middle schools use a "house" approach where four academic teachers have the same group of children. The teachers meet periodically to determine the class schedule for those students and what is to be taught during a given period of time. Such joint planning facilitates the use of team teaching and the development of interdisciplinary courses. This was another reason for choosing the middle school years as a focus for Ohio Sea Grant efforts. Also, following 8th or 9th grade, the curriculum begins to diverge, with course options being offered to students. The middle school therefore is the last time to have all students enrolled in a given course as a "captive audience" for marine education facts and concepts.

Experience with the implementation of "new" curricula during the advent of the National Science Foundation sponsored curriculum development efforts, and subsequent experience with schools, indicated the difficulty of inserting new materials into existing curricula (Helgeson, et al., 1978). Teachers by and large are satisfied with what they are doing in the classroom. They are not looking for a new curriculum, or even for major new units to teach. The concept of infusion therefore was adapted from efforts of the Crustal Evolution Education Project as a guiding theme for the development of OEAGLS materials. Instead of producing units, self-contained, short and supplementary modules were designed. These focused on concepts already taught in the curriculum, but imbedded them in a marine and Lake Erie, or Great Lakes, context. A module on shipping, for example, uses data from the Port of Toledo to develop ideas related to the worldwide involvement of Ohio in commerce. "Pollution in Lake Erie" uses articles from 1970 and 1980 for two language arts activities--reading in the science content area and critical reading.

Each module was designed to take only a few days of class time. A combination

Fifth graders study a "plankton sample" during OEAGLS estuary activity.

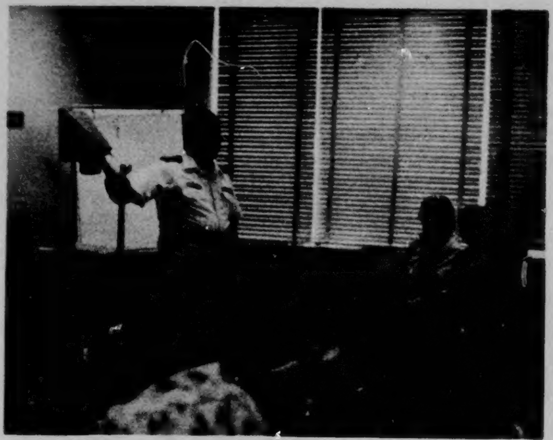
therefore of familiar concepts and the short time necessary for the full treatment of each topic facilitates the use of the materials and their incorporation into existing curricula. To further facilitate use of the materials teachers need to have information beyond what is normally included in a student guide. Therefore a fully detailed teacher guide was developed for each activity. The guides included descriptions of the necessary materials and where they could be obtained, answers to questions in the student guide and background information necessary for the teacher to understand the topic. Such fully detailed guides also decrease the necessity for teacher training in the use of the activities. A project incorporating these concepts was prepared and submitted with the 1977 Ohio Sea Grant proposal.

The Development Process

Advisory Committee. Soon after the announcement of the grant an advisory committee was named to assist in overseeing the project. The primary functions of the committee were to establish priorities for topics of the activities, to help in identifying resource persons, and to review the content of the activities for accuracy, relevancy and appropriateness. Individuals on the committee represented the Ohio Department of Natural Resources, the Ohio Department of Education, the Navy League of the United States, the Departments of Geography and Naval Science of the university and the Center for Lake Erie Area Research. The committee had several meetings to discuss general policy, but its primary mode of operation was for its members to serve in individual consulting roles with the principal investigator. In this respect it became one of the primary resources of the project, assisting the principal investigator in deciding policy issues as they arose and in identifying individuals to aid in the development of certain topics and to review materials as they were developed.

Identification of topics. The development process was initiated with the identification of broad topic areas. This was done on a tentative basis in the proposal based upon the principal investigator's knowledge of the school curricula, experience with teacher workshops, and knowledge of research being conducted on the Great Lakes. These topics were reviewed and modified at the first advisory board meeting and then ranked by the members in order of priority for development. Subsequently the principal investigator and his two project assistants "brain stormed" more specific subjects within those broad topics that the board ranked as being most important. These more specific topics then became the bases for the development of activities during the first year of the project and provided guidance for the identification of activity topics in subsequent years as well.

Creation of activities. Once topics were identified, several different processes were used for the initial development of an activity. One such process started with activities that had been developed by teachers as course projects for the three Humanities of the Seas workshops conducted with Navy League sponsorship. Another process used during the first year involved a teacher seminar on OEAGLS development. Eight teachers were enrolled for three hours of graduate credit. They met once a week during the University's Winter Quarter, 1978. Each meeting included a presentation on a priority development topic by a content expert. These included, among others, a geologist with the Ohio Department of Natural Resources who discussed his studies of beach erosion along the lake, a meteorologist from the Cleveland weather station of NOAA who discussed the weather and climate effects of the lake, and a geographer from the university who discussed the effect of waterways on the settlement of Ohio. Each of the teachers identified a topic area and designed an activity relating to that topic using the resources of the developing Marine and Aquatic Education Resource Center as a support library. Eleven of the activities were started in one of these two ways.



Curriculum development seminar produced some activities.

Beginning the second year greater initiative for activity development occurred within the project staff itself. This was in a large part due to the arrival on the staff of a professional qualified in Marine Education, Dr. Fortner. This change in procedures was also in part a response to the need to develop topics on emerging issues such as the PCB problem in the lakes. A fourth process used in three cases was the designation of either a teacher or a researcher on lake problems to initially develop an activity.

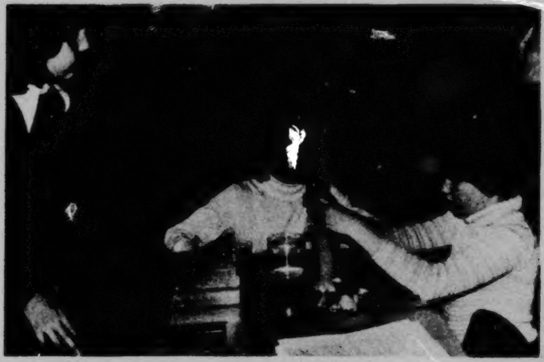
The original draft of any activity idea was submitted to a second and often a third person for revision and editing. If initially developed by a teacher, then one of the project staff completed this second step. If started by a member of the project staff, then usually a teacher was asked to review the activity.

Teacher Dorothy Bries originated "We Have Met the Enemy" for OEAGLS.

At various stages in the writing, content experts were consulted for additional information, for references to research that could assist in developing the content of the activity, and for opinions on the appropriateness of information.

Evaluation. When reviews by critic teachers were completed a different teacher was identified and asked to use the activity with his/her classes. The teacher was identified by the principal investigator, based on his experience with teachers in local schools and through recommendations by his colleagues at the university and in the local school systems. An important criterion used in selection of teachers was the teacher's ability to identify strong and weak points in instructional programs.

Each activity was systematically evaluated through its use in the selected teacher's classes. Multiple choice items were developed to assess whether the objectives of the activity were met (Appendix A). These items were given to the students prior to the use of the activity and then again following its completion. The results were analyzed to identify any areas of low achievement. If such areas were found, the related objectives were examined and the sections of the activity relating to those objectives were analyzed for problems.



Students tested OEAGLS before final drafts were prepared.

In addition, students in the pilot classes responded to three attitude items. Their responses were analyzed to determine the interest level, difficulty and clarity of the activity. If problems were indicated, the activity was examined for ways in which it could be made more appealing or clearer to students. In addition to evaluation through test data, the teacher was asked to critique the activity and its various components using a standard form provided by the project (Appendix B).

Perhaps the most useful component of the evaluation process was the visits to the pilot classes by one of the two principal investigators. They were able to observe student reactions to the activity, interview selected students and discuss the activity personally with the teacher.

All of the information from the evaluation process was then used to rewrite the activity. If very extensive rewriting was necessary then the activity was retested in another classroom. The final stage in evaluation was the submission of the activity to a content expert who provided a final review of the accuracy of the subject matter. After adjustments made necessary by the content review were completed, the activity was then ready for distribution to teachers.

In a sense, the evaluation process is still continuing. As activities are used in workshops, teachers note ways in which they can be improved. When the supply of an activity is exhausted, it is revised before reprinting to take into account suggestions by teachers.

The extensive and many faceted evaluation system used for OEAGLS has been more completely documented in a case study of the program written by Gregory Rhodes as a portion of his doctoral dissertation at Indiana University (Rhodes, 1983, Appendix C).

Dissemination Programs

When the OEAGLS project was first proposed it was realized that there had to be a dissemination process to follow the development program. Since the format of the materials and the philosophy behind their development precluded publication by a commercial publisher, some mechanism had to be provided to make the materials known to Ohio teachers and to get them into their hands for use. This dissemination program took the form of a planned and coordinated series of workshops conducted over the three year period immediately following the completion of the OEAGLS Project in 1980.

Activities During Development Process. Actually dissemination started as a part of the development process since educators were made aware of the availability of the materials through a newsletter started during the second year of the project (Appendix D). Entitled Middle Sea, it now has a quarterly distribution of about 1400 copies primarily in Ohio. Each of the OEAGLS has been described in the newsletter. Early in the project it was a primary means of making teachers aware of their availability, and each issue resulted in a flurry of orders for new activities. After all activities were completed a catalog was written that included activity descriptions, a description of the development process and lists of authors and project personnel (Appendix E).

As materials became available, interest in their use was generated along Lake Erie through the work of the Ohio Sea Grant advisory agent. Many activities were disseminated through that office and through workshops organized by the agent. The principal investigators also accepted any opportunity to make presentations at teachers' meetings anywhere in the state. OEAGLS were invariably used in the workshops and presentations. Programs have been given at school system inservice days, regional meetings of the Ohio Education Association, and annual meetings of state science and social studies organizations. In addition, presentations have been made by the principal investigators at national and regional meetings of the National Science Teachers Association and national meetings of the National Marine Education Association, the National Association for Environmental Education and the Association of Interpretive Naturalists. During the latter two years of the development project, these measures resulted in the distribution of several thousand copies of the OEAGLS materials.

Advisory agent Fred Snyder working with students at Old Woman Creek estuary.

As another element of the dissemination process, activities are published in a form that readily facilitates their inexpensive use by teachers. Only single copies are provided to teachers, who are then encouraged to have as many copies reproduced as necessary. To facilitate this all materials are printed in high contrast black and white. Illustrations are line drawings with occasional black and white photos and art work. This type of publication also facilitates a second method of dissemination through national microfiche based information dissemination networks. All activities have been included in both the Educational Resources Information Center (ERIC) and the Marine Education Materials System (MEMS). Both systems provide computer searches for materials. The ERIC system also publishes abstracts of the materials in a monthly publication Resources in Education. Most colleges and universities maintain ERIC microfiche collections as do state departments of education. Through these dissemination methods the materials are made available throughout the country at no cost to the project.

Infusion Program. Enough experience has been gained with curriculum development projects, especially those funded by the National Science Foundation through the 1960's and '70's, to demonstrate the necessity of well planned and executed dissemination programs. This was realized from the inception of the OEAGLS development project and led to the early design and proposal for a dissemination program later referred to as the Infusion Program. This program was conceived as a three year cycle to promote awareness of the materials throughout the State of Ohio. It was designed to systematically introduce the materials to every section of the state through a series of awareness workshops and to develop a cadre of well trained teachers centered in the major metropolitan areas of the state through a series of implementation workshops. The program was designed with the cooperation of the Ohio Department of Education. The co-principal investigator on the project during its first year and one-half was Dr. John Hug, Coordinator of Environmental Education for the Department.

The two components of the program were designated the awareness component and the implementation component. The first was intended to develop broad awareness among teachers and administrators across the State of Ohio regarding the objectives of marine and aquatic education and a knowledge of the materials available for use in teaching toward those objectives, especially the OEAGLS materials. The implementation component was intended for in depth training of teachers to provide them with information and resources to implement marine and aquatic education in their classrooms. Many of these teachers could then serve as a trained cadre who could be called upon to assist others in such an effort.

The objectives of the awareness component as stated in the proposal were to:

a. Create an awareness of marine and aquatic education among school administrators, supervisors, and teachers.

b. Disseminate examples of curriculum materials available in marine and aquatic education.

c. Create an awareness of marine and aquatic education among selected educators in Ohio colleges and universities.

These objectives were to be reached through several program elements:

a. The establishment of a marine and aquatic education awareness program through the Ohio Department of Education.

b. The planning and implementation of a statewide awareness program for local school administrators and faculty of colleges of education.

c. Conducting a marine and aquatic education awareness program for Ohio teachers.

These objectives and program elements were characterized as the awareness component of the program and were led by the project's co-principal investigator, Dr. Hug, during the first year of the project, and by Dr. Fortner during the remainder of the program.

The implementation component led by Dr. Mayer had another set of objectives, to:

a. Assist teachers to effectively use available curriculum materials and methods.

b. Help teachers acquire appropriate background information in marine and aquatic topics.

c. Provide teachers with marine and aquatic experiences through field trips.

d. Assist administrators and teachers in redesigning curricula to infuse marine and aquatic education.

These objectives were to be accomplished through:

a. Coordination of implementation activities by Ohio Sea Grant through the Ohio Department of Education.

b. Provision of inservice and summer seminars and workshops in marine and aquatic education through The Ohio State University.

c. Establishment of similar courses at other universities in Ohio.

d. Provision of an educational specialist to work through the Ohio Department of Education in assisting teachers in implementing marine and aquatic education.

e. Loaning marine and aquatic education materials from three resource centers.

f. Publishing a quarterly bulletin in marine and aquatic education for Ohio teachers.

Awareness Program Component. This component had three major tasks: the further identification and organization of marine and aquatic education resources, the development of the capability to deliver services to educators in Ohio schools, and the planning and initiation of an awareness program for Ohio educators.

During the first year the emphasis was upon the first two tasks. Lists of materials available through ERIC and MEMS were updated and microfiche copies added to the Oceanic Education Resource Center. This resource center located at Ohio State began as an adjunct to the OEAGLS development project providing source materials for the development staff. Its resources had been expanded in support of early marine education workshops through funding by the Columbus Council of the Navy League of the United States. Additional books, curricular materials, slide-tape sets, laboratory and demonstration materials were added during the infusion program.

Oceanic Education Resource Center at The Ohio State University

Also during the first year two additional resource centers were instituted, one at Bowling Green State University in the northern part of the state and the other at the University of Cincinnati. The holdings of the Columbus resource center were evaluated and those materials judged most useful were purchased for the two new centers. These satellite centers have been used in support of both awareness and implementation workshops held in those areas. Their major use, however, has been by local teachers and students at the two universities.

Personnel resources were also identified during the first year. Over 50 teachers had been involved in Oceanic Education programs conducted at the Ohio State University with support from the Navy League. Exceptional teacher leaders were identified from this group. The State Department of Education identified additional administrators, supervisors and faculty in institutions of higher education. A state-wide meeting of individuals selected from those groups was held in Columbus. At this meeting guidelines were developed for the conduct of the awareness program. This group, although its membership has changed a bit as the program has evolved, has continued to serve in an advisory capacity, reacting to ideas of the project staff and in some cases initiating programs in marine and aquatic education in colleges and universities in their areas of the state.

To assist in disseminating an awareness of marine education throughout the state and defining the importance and scope of marine and aquatic education in Ohio, a position paper was developed with the Ohio Department of Education. "Occasional Paper #6: Marine and Aquatic Education" has been distributed to Department personnel and to educators contacted by the Sea Grant Education Program (Appendix F). The document serves to introduce the subject, the program and the personal, geographic and educational resources of the state.

Perhaps the major task during the first year was to develop a format for the awareness workshops. These were to offer one quarter hour of graduate university credit. This fact resulted in two requirements, first that they involve a minimum of 10 clock hours of instruction, and second that each participant write a paper. The format developed during this first year was piloted in two workshops, one held in Columbus and the other on Lake Erie at Ottawa National Wildlife Refuge. During the second year this program was modified to take into account recommendations by participants. A sample program is included as Figure 2.

Dr. Fortner directing teachers in the use of OEAGLS.

In conducting the program several guidelines were followed. First, a major portion of the time should be devoted to active teacher involvement in OEAGLS activities. This has proved a key to use of new materials by teachers. Second, teachers were to be provided with background knowledge about the characteristics of Lake Erie. This has been achieved through two lecture presentations, one on the geology of the lake and one on the characteristics of the water of the lake. These presentations have been highly refined using extensive illustrations in the form of slides and overhead visuals. A third guideline was to provide opportunities to become familiar with a wide variety of activities and curriculum materials. Two sessions were held to accomplish this purpose: one during the first evening in which participants could informally participate in a variety of different activities set up as learning stations, and one the following day where teachers were given the opportunity of perusing the best of the curriculum materials from the resource center.

Dr. Mayer assisting participants in food pyramid game.

Marine and Aquatic Education Workshop
Miamisburg, February 11-12, 1983

SCHEDULE

February 11

6:30 p.m.	Individual participation in marine and aquatic education activities
7:00	Welcome and workshop overview - Rosanne Fortner
7:10	Overview of Marine and Aquatic Education - Vic Mayer
7:45	Break
8:00	Yellow Perch in Lake Erie - Rosanne
8:30	The development of the OEAGLS materials - Vic
8:45	Programs and services of Ohio Sea Grant - Rosanne
9:05	Briefing on tomorrow's activities
9:15	Registration for credit
9:30	Have a safe trip home!

February 12

9:00 a.m.	Formation of Lake Erie - Vic Mayer	
9:30	Concurrent sessions:	Erosion Along Lake Erie - Carol Winhusen Ohio Canals - Jane Muhlencamp PCBs in Fish - Roberta Rupert
10:30	Break	
10:45	Characteristics of Lake Erie - Rosanne Fortner	
11:15	Concurrent sessions:	Getting to Know Your Local Fish - Roberta How to Protect a River - Vic It's Everyone's Sea: Or Is It? - Jane
12:15 p.m.	Lunch	
1:15	View and browse displayed curriculum materials	
1:45	Local resources for marine and aquatic education - Bob Earl	
2:15	Concurrent sessions:	The Great Lakes Triangle - Carol Estuary: A Special Place - Rosanne We Have Met the Enemy - Vic
3:15	Great Lakes Filmstrip	
3:45	Workshop wrap-up	
4:00	Adjourn	

Figure 2
Awareness Workshop Schedule

A major goal of the workshop was for teachers to develop an understanding of the breadth and scope of marine and aquatic education. The workshop itself helped to provide this, but an introductory lecture "Why Marine Education" provided an overview of the sources of the marine and aquatic education movement and its interdisciplinary nature.

NSF workshop participants studied on the lake shore as well as in classes.

To assist in conducting these workshops it was initially envisioned that 10 leadership teams would be trained. Each team would then conduct a workshop under the supervision of the Sea Grant staff. This training program was initiated in the summer of 1980 under a grant from the National Science Foundation. Nine administrator-teacher teams were invited to a six-day workshop at the University's Stone Lab facilities on South Bass Island in Lake Erie. Participants in this workshop ranged from a team consisting of an assistant principal with a fifth and a sixth grade teacher to one having a curriculum supervisor with junior high school science and social studies teachers. Though attempts were made to gain participation from a wide geographic area in order to have a statewide leadership cadre, applicants were largely from the lake shore areas.

The six-day program consisted of lectures on interdisciplinary topics in social studies, science and the arts, followed by OEAGLS sessions to illustrate methods of presenting those topics in middle schools. Field trips to island sites such as Perry's Victory and International Peace Memorial, and mainland features such as the Port of Toledo and the Kishman Fish Company reinforced class concepts and emphasized the importance of the lake to the state. Presentations by the Director of Ohio Sea Grant and by curriculum developers from Michigan Sea Grant helped to broaden the experience.

Although the program was a success in terms of participant enthusiasm, it subsequently became clear that very few of the teams were adequately prepared to deliver the intense, high quality type of workshop envisioned by the Sea Grant staff. Instead a decision was made to reduce the number of workshops offered to six per year, and to have them staffed by the principal investigators of the program, both of whom were also graduate faculty at the university. Assisting the lead staff would be several local teachers. These individuals would conduct many of the OEAGLS activities presented at the workshops. They were selected from participants in previous workshops, such as the NSF supported program held in 1980.

A critical element in the planning and conduct of the one day workshops was evolved between the second and third year of the program. Prior to the second year, a team consisting of Dr. Hug and a graduate assistant working in the program visited each site that was to host a workshop. Their primary purpose was to review the facilities to be used and to renew contacts with local environmental educators who, it was thought, could assist in the presentation of the workshop and in recruitment of teachers. These visits were reasonably successful in accomplishing their purposes. At one location the local contact person was an assistant superintendent of the county school system. He was extremely effective in coordinating local arrangements for the workshop and in advertising it among the teachers in his county school system. Using that experience as a cue, prior to the third year of the program the two principal investigators visited each of the six localities chosen for the workshop and met with administrators from the city and county school systems. In all but two cases they were able to secure excellent cooperation from the administration, who agreed to inform school principals regarding the nature and objectives of the program, and to distribute information about the program to teachers through the school courier service.

An important factor in the success of the awareness workshops was the continued attention of the project staff to workshop evaluations. Two types of evaluations were done for each program. First, a three item evaluation was completed by participants following each major presentation and each concurrent session (see Figure 3). The items indicated interest in the session, the importance of the material and whether the participant planned to use the information presented. When all forms were collected for any one session, the presenter of that session was able to gain immediate feedback on its effects. The project staff was also able to perceive immediate needs of the total group and make adjustments in approach or scheduling to meet those needs. The short forms therefore served as a formative evaluation and to identify problem areas that might affect responses on the second type of evaluation.

At the end of each awareness workshop all participants completed an open-ended questionnaire in which they expressed their attitudes about the atmosphere of the workshop, its value to their teaching, and changes that might be made to improve future workshops. Participants in inland workshops were also asked whether they felt that Lake Erie was important to teach about in their geographic area. This summative evaluation provided an overall indication of the workshops' impacts. The long evaluation forms are included as Appendix G. Records of the Education Program contain synopses of all the awareness workshop evaluations, from which it is possible to chart the continued growth and responsiveness that contributed to the Infusion Program's success.

During the second and third years of the infusion program 12 workshops were conducted over the State of Ohio. Figure 4 includes maps of Ohio showing the locations of each year's workshops and the areas from which participants were drawn. Over 600 teachers and administrators were enrolled and some 4000 OEAGLS activities distributed through the program.

Name of Presentation ______________________________

1. The presentation was
   1. very interesting
   2. interesting
   3. somewhat interesting
   4. not very interesting
   5. boring

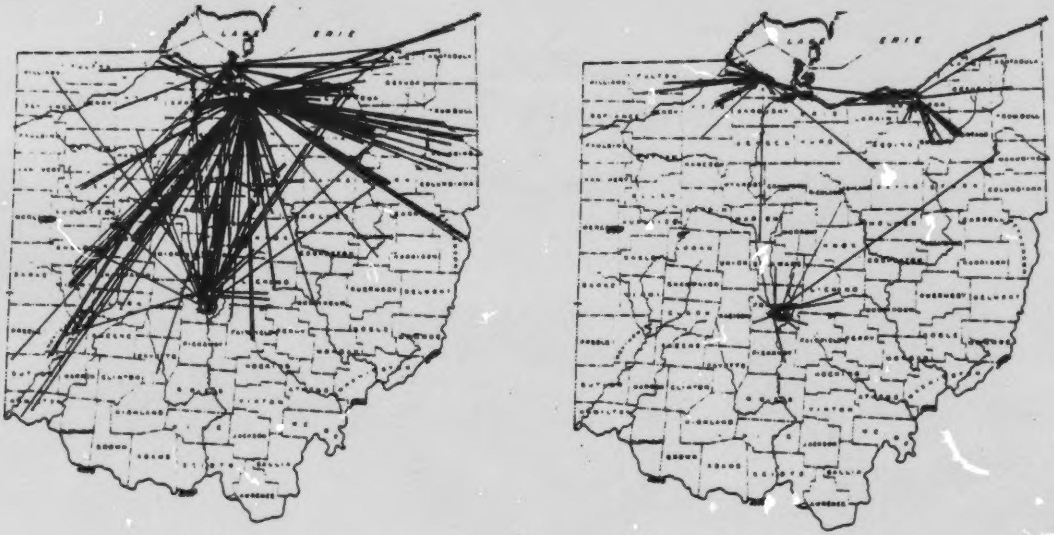
2. My knowledge level
   1. increased greatly 2. increased somewhat 3. did not change

3. I (circle) will / will not use the material presented

COMMENTS:

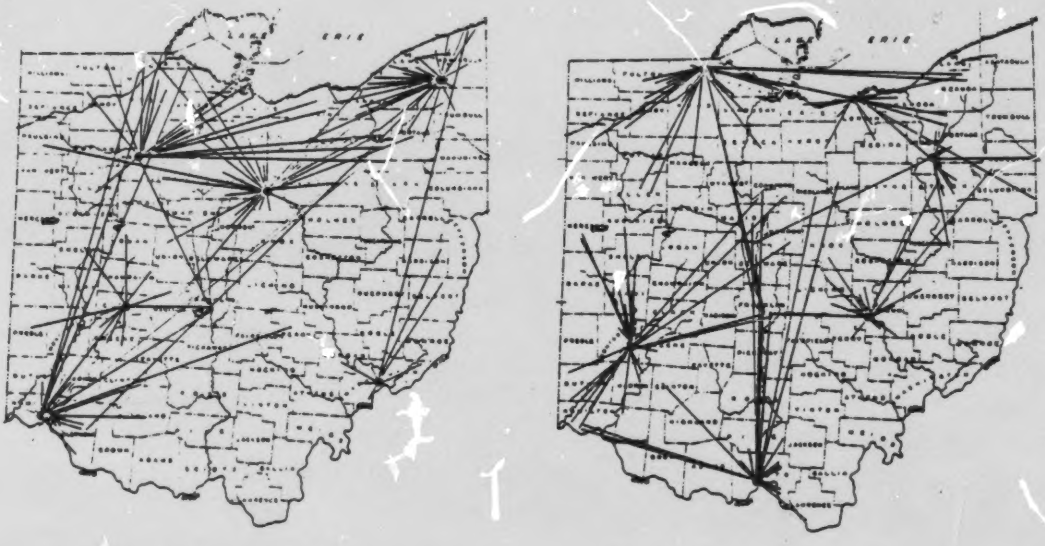
Figure 3

Session Evaluation Form


LAKE ERIE
LAKE ERIE

A. Pre-infusion Activities 1976-79

B. Infusion, Year 1


LAKE ERIE
LAKE ERIE

C. Infusion, Year 2

D. Infusion, Year 3

Figure 4.

Activity Sites with Attendance Areas, 1976-83

Another awareness task of the Infusion Project was to continue publication of Middle Sea. This newsletter had become recognized as one of the best of its kind in marine and aquatic education. With the initiation of the infusion program, however, its focus changed from emphasis on new OEAGLS activities to one of broader service to teachers. Each issue has a feature article dealing with information on Lake Erie of use to teachers, a classroom activity, reviews of teaching materials or publications and announcements of events of interest to teachers. The variety of Middle Sea articles reemphasizes the interdisciplinary nature of marine and aquatic education and highlights the workshops, publications and plans of the Sea Grant program (Appendix D). This has proved to be an excellent vehicle for keeping in contact with teachers who have participated in the workshops. It serves as a reminder of the availability of activities and materials in marine and aquatic education, and of the interest of the Sea Grant staff in the activities of the teachers it has served.

Implementation Component. The tasks of this component as specified in the proposal were to extend opportunities to Ohio teachers for obtaining in-depth background in knowledge and curricular materials related to marine and aquatic education, and to provide continuing assistance to Ohio educators.

The implementation component was founded on two types of courses. The first was the Humanities of the Seas series of three summer workshops beginning in 1976. These were supported by the Columbus Council of the Navy League of the United States. The second was an inservice seminar in Marine and Aquatic Education piloted in the spring of 1979 in Mansfield, Ohio. The summer workshop was relatively expensive because it included an extended field trip along the Lake Erie shore. As Navy League funding was exhausted these costs had to be borne by the teacher participants. Also, tuition had to be charged. When field trip expenses plus tuition had to be paid by participants the cost became prohibitive. In the summer of 1978, with partial funding from the Navy League, only seven teachers took the workshop. The original rationale then was to bring both programs under Sea Grant, allowing the university to waive tuition, and to provide funds to defray the expenses of the field trip. Under those conditions the courses would be accessible to a much larger number of teachers.

A Coast Guard cutter was included in a tour by Navy League workshop participants.

The inservice course that is part of the Infusion Program has been offered in three different locations in central Ohio: Westerville Public Schools, Southwest City Schools and the Newark Campus of The Ohio State University. Offering the course in off campus locations was another way of making it more accessible to teachers. About 90 teachers have enrolled in the three-quarter-hour graduate credit course. The summer course has been offered at the Cleveland Museum of Natural History, at the Cincinnati Zoo, and at one of the Toledo Metropolitan Parks. Over 90 teachers have been enrolled, receiving four to five hours of credit.

The inservice program was scheduled for ten 2.5-hour evening sessions and one all day field trip. The summer workshops met for one-half day every day for two weeks and included one all-day field trip. In addition the summer program included optional activities offered by the institution in which the sessions were being held. For example the staff of the Cincinnati Zoo conducted sessions on marine and aquatic reptiles, endangered species and several other topics. These sessions included tours of the appropriate sections of the zoo. Both summer and inservice programs focus on use of OEAGLS materials in presenting information regarding the Great Lakes and the Oceans. A sample syllabus is included as Appendix H.

In-depth exploration of activities was possible in implementation sessions.

The content of both types of programs is similar. Lake Erie and the Great Lakes are used as a focus for teaching content information about the world's large bodies of water. Implications of a concept for the oceans and lakes are drawn through discussions, lectures, activities and visual aids. Content from all relevant disciplines is presented. In addition to the science related content usually associated with courses about water, significant time is devoted to the visual arts, music, literature and crafts. Concepts in history, economics and transportation are presented. Each topic is developed through an activity. Most are the OEAGLS activities, but others are drawn from the Crustal Evolution Education Project, Project COAST, and Ocean Related Curriculum Activities (ORCA). Each activity used becomes a basis for discussing the concept in greater depth, providing teachers with the confidence necessary to adequately teach the concept in their own classes. This type of approach requires a great deal of instructor time for dealing with the many personal interactions that result. Therefore either two faculty or one faculty and one graduate assistant have staffed each of the courses. This type of staffing seems adequate for class sizes up to about 40.

Teachers from Southwest City Schools had a sailing lesson as part of their course.

Field experiences have been incorporated into each of the implementation workshops. These normally consist of a one day field trip adapted to the locality. For example, in Cincinnati, along the Ohio River, the class visited a marina and docking facilities, and also a vocational program that trained workers for the river transportation industry. Since Cincinnati is a world famous collecting locality for Ordovician fossils, a lunch stop was planned so that teachers could observe and collect a variety of fossils. The Cleveland workshop included a trip along the lake shore to study erosional and depositional features, and to visit a marina, factory sites and a small marine museum. Field experiences are designed to reflect the interdisciplinary nature of marine and aquatic education, therefore not only science localities are visited but also those of economic and historic significance. The maps in Figure 4 indicate the locations of implementation workshops and field experiences for each year of the project.

FUTURE DIRECTIONS FOR TEACHER EDUCATION

The infusion program will terminate in August of 1983. Experiences with the NSF science curriculum development projects and other innovative efforts in curriculum change have demonstrated that unless continuing assistance is provided to schools such new efforts ultimately are replaced by other curriculum developments or teachers revert to the older, more comfortable materials used prior to the implementation program. To avoid this, the Infusion Program as originally conceived proposed the eventual establishment of a marine and aquatic education specialist to work through a Sea Grant education office in cooperation with the Ohio Department of Education. Because of cutbacks in funding and changing priorities of the national Office of Sea Grant, such a position has not been possible. Instead other ways must be found to insure that the efforts started with the OEAGLS and Infusion Programs are sustained. Methods are now being explored through which further dissemination of OEAGLS and infusion of marine and aquatic concepts in teaching can be accomplished. It is hoped that school systems can be encouraged to assume major responsibility for these efforts with assurance of professional support from the Sea Grant Education Program. To abandon infusion and teacher education efforts in a time of economic hardship for schools would orphan those programs in their infancy.

Summative Evaluation of OEAGLS and Infusion Programs

The major thrust of the Ohio Sea Grant Education Program has been at the middle school level and consists of the OEAGLS project and the Infusion project. A unique summative evaluation has been planned for this entire program.

Questions to be answered. A variety of data sources will be used to examine questions related to the effectiveness of the overall middle school program and its two components: the OEAGLS curriculum development effort and the Infusion program. The following questions will be examined:

1. Effectiveness of components:
    a. Does a four week unit comprised of OEAGLS materials improve knowledge and attitudes toward Lake Erie and the world's oceans?
    b. Do extended workshops increase the probability of sustained use of OEAGLS materials preferentially as compared to the one-day workshops?
    c. Do workshops increase the probability of sustained use of OEAGLS materials over volunteer orders and distribution of activities through the Lake Erie program of the Center of Science and Industry (COSI)?
2. Overall effectiveness of the model:
    a. Have student attitudes and knowledge regarding Lake Erie and the oceans improved over the interval in which OEAGLS materials were being actively disseminated through the Infusion program?
    b. Have student perceptions of their sources of knowledge regarding marine and aquatic education changed during this interval?

Description of Research. The evaluation program will be divided into three components, each having a different focus and methodology. Together the data from the three components will be used to answer the questions posed above.

The first component will test a four week long unit composed entirely of OEAGLS activities. In the formative evaluation the OEAGLS materials were evaluated using pre-post testing procedures with the classes of a single teacher. Although adequate for the purposes of the development process, this procedure did not provide the type of data that would permit an assessment of the overall effectiveness of the materials in changing student understanding of aquatic and oceanic information nor how the materials might have affected attitudes toward the oceans and Lake Erie or the Great Lakes generally. This type of assessment can only be made when students have had sufficient time of exposure to such materials, more than the day or two that a single OEAGLS activity typically takes. Therefore a unit of minimum length of four weeks will be designed entirely from OEAGLS activities. This unit will be used in at least one school with all of the students of a single teacher. Usually this means five classes of about thirty students each. The classes chosen will be either at the eighth or ninth grade level, as this is the level for which most of the activities were designed. These classes will serve as the pilot group. At least two other teachers will be identified. One will be in the same school as the pilot teacher. These classes will serve as the comparison groups.

Data will be collected on knowledge of the content of the unit and on student attitudes toward Lake Erie and the oceans. Knowledge will be assessed through the use of a multiple choice pretest and posttest. Items developed for use in the formative evaluation of the OEAGLS activities will be used as the basis for this test. If necessary additional items will be developed and piloted prior to their use in the study. The same tests will be used with the pilot and comparison groups. Any differential in performance between the two types of groups can be ascribed to the use of the OEAGLS unit. Analysis procedures will consist of standard T-tests performed on means to detect the significance of differences between the two types of groups. If necessary covariance techniques can be used to adjust for initial differences between groups on pretests. Item analyses will also be performed to insure the quality of the items.

Attitudes will be assessed through the use of an innovative intensive time series design being developed at Ohio State (Mayer and Monk, 1983). Items originally used in the baseline study (Fortner and Mayer, 1983, Appendix I) will be adapted for use. These are of the semantic differential format and focus on attitudes children hold toward Lake Erie and the ocean. Additional items from ongoing studies using the intensive time series design will be used to assess attitudes toward the class and teacher. One item will be randomly selected from each of the four types of items for each student for each day. Therefore each student in a given class will have a different test and no student will receive the same test until all items have been used. A computer program has been developed for selecting items and printing student test forms. Data will be collected according to the following design:

Pilot group
$0_{\underline{1}},0_{\underline{2}},\ldots 0K_{\underline{10}},I0_{\underline{11}},\ldots I0K_{\underline{30}},0_{\underline{31}},\ldots 0_{\underline{45}}$

Comparison groups
$0_{\underline{1}},0_{\underline{2}},\ldots 0K_{\underline{10}},0_{\underline{11}},\ldots 0K_{\underline{30}},0_{\underline{31}},\ldots 0_{\underline{45}}$

0=Observation (Attitude assessment)
K=Knowledge assessment
I=Treatment or unit
The numbers are class days.

Daily means will be computed for each pilot group and for each comparison group. Data from the items focusing on Lake Erie and the oceans will be considered dependent variables. Those relating to teacher and class will be considered environmental variables. Analyses used will be time series analyses programs. Regression between environmental and dependent variables will be factored into the analysis programs to compensate for variances introduced into attitudes from those two sources.

The introduction of the OEAGLS unit should positively affect the slope of the curve generated by the daily assessment of attitudes. This should happen with the pilot group(s) but not with the comparison groups. In addition daily fluctuations in attitudes may be related to specific activities being used. A teacher log will be kept of these daily activities to assist in the interpretation of the data.

Component two will consist of a survey of teachers who have received copies of OEAGLS activities. A questionnaire will be developed to obtain the following information:

1. Names of OEAGLS used in the teacher's classes during the year the questionnaire was received.

2. Number of class periods during the year in which OEAGLS activities had been used.

3. Names of other teachers in the area that have used OEAGLS activities at the suggestion of the respondent.

4. Names of OEAGLS activities used at one time by the teacher but no longer used. The teacher will also be asked to provide a reason for non-use of the activities.

5. The number of years a particular activity has been used by the respondent.

6. The respondent's opinion regarding the general quality of the activities being used and student reactions to those activities.

Before use the questionnaire will be piloted with several OEAGLS users in the Columbus area. It will be kept simple to insure ease of completion, thereby enhancing the expected percentage of response.

The following populations will be sent the questionnaire:

1. Participants in the short awareness workshops. About 600 teachers will be included in this population.
2. Participants in the two-week long summer workshops and those in the quarter-long inservice workshops. About 180 teachers are included.
3. Teachers who have ordered OEAGLS from the Education Office, but have not been enrolled in any of the Sea Grant workshops. There are about 200 teachers in this population.
4. Teachers who received a copy of an activity as a result of participating in the Lake Erie program of the Center of Science and Industry. There are about 300 teachers in this population.

A 40 percent random sample will be chosen from each of the populations. A questionnaire will be mailed to each individual. A follow-up questionnaire will be mailed to the non-respondents. A random sample of those teachers not responding to the follow-up will be telephoned and their responses taken in this manner. Their responses will be tabulated separately to generate information as to differences between respondents and non-respondents to be used in the interpretation of the results.

Responses for each of the four populations will be tabulated separately. Comparisons will be made between each of the four populations. T-tests to determine the significance of any differences between means will be performed. Correlations between activity use and time at which the workshop was attended will be determined for the awareness and implementation populations. These analyses should allow determination of the relative effectiveness of the four different modes of dissemination based upon current usage by respondents, as well as degree of influence respondents had in their areas for additional distribution and use of activities by other teachers. The correlations will permit an assessment of the relative permanence of implementation with each of the four means of dissemination.

Component three will be a follow-up survey of knowledge and attitudes of Ohio children regarding the Great Lakes and the oceans. The Fortner and Mayer survey conducted in 1979 (Appendix I) provides baseline data for this research project.

The following types of data were obtained in that study:

1. knowledge of the Great Lakes and oceans in the areas of science, humanities, and social studies;
2. attitudes toward Lake Erie and the oceans; and
3. student perceptions of the relative importance of their sources of knowledge regarding the Great Lakes and the oceans.

To obtain these data a survey was constructed consisting of multiple choice achievement items, semantic differential attitude items and a series of multiple choice experience items. A 4 percent random sample of all schools with fifth grades was chosen and a 10 percent random sample of all schools with ninth grades. The survey was administered to one class of students in each of the schools in each of the samples.

In the summative evaluation this survey will be repeated. New random samples of fifth grade and ninth grade schools will be chosen and the survey administered.

One modification will be made to the survey. In the 1979 study the items used for assessing knowledge were of a general nature. None were specific to the OEAGLS materials. In the follow-up survey there will be a section of multiple choice items that will be specific to OEAGLS. These will provide a baseline on the current level of knowledge regarding that information.

The following analyses will be conducted. Knowledge scores from the 1979 study in science, humanities and social studies will be compared with those from the summative study. Since the Infusion Program was targeted at the middle school level, no substantial change should be noticed in the fifth grade scores. Any differences at the ninth grade level could be attributed in large part to the Infusion Program and would be a demonstration of its overall effectiveness.

The attitude data will be examined in a similar way. It would be hoped that ninth grade students will exhibit strong positive gains in attitudes toward both Lake Erie and the oceans.

Student perceptions of sources of marine and aquatic information will be compared between the two surveys. School sources should be perceived as being significantly more important among ninth graders in the summative study.

This survey should be repeated on a three to four year cycle. The education program will be inaugurating a new three year teacher training system. The survey repeated at the end of that cycle would be able to provide information relating to the effectiveness of that program. This is the major reason for including a section on the survey relating specifically to knowledge contained in the OEAGLS materials. Any gains in that knowledge can then be monitored in subsequent surveys providing a measure of the effectiveness of those materials combined with Sea Grant dissemination efforts.

Implications for Ohio Sea Grant Education Program. Locally the summative evaluation will influence the methods of dissemination used by Ohio Sea Grant for its materials. For the first time detailed information will be available on the effectiveness of long versus short workshops and the effectiveness of volunteer distribution versus formal dissemination efforts such as workshops. Workshops are relatively expensive to conduct. If short ones are as effective as long ones for sustained use of materials then they can be used in preference to the longer format. With this type of data, a cost benefit analysis can be performed to determine the most cost effective means of disseminating curriculum materials and information to Ohio schools.

Efforts in Higher Education

Because of the prospect of limited funding and the relative adequacy of university programs in limnology, fisheries and other aquatic degree oriented programs, the focus for the Ohio Sea Grant Education Program was and will probably remain at the pre-college level. However there have been two major efforts focused at higher education. The first was a project at Bowling Green State University to develop a curriculum in marine technology. This began as an effort to be funded jointly by industries in the northern Ohio area, interested in obtaining well qualified personnel for employment in the building trades to work with construction problems along the lake shore. Because of the characteristics of materials and processes occurring along the lake shore, the unique problems associated with the construction of structures such as piers, breakwalls, groins, and building foundations, required the specialized training of foremen and construction engineers. Unfortunately, reorganization problems at Bowling Green have delayed the initiation of this program. Although a curriculum has been prepared, the program has not yet been implemented.

With the major objectives of the pre-college program within sight of being firmly established, a decision was made in 1981 to conduct a needs assessment of courses and programs in higher education in the State of Ohio. It was felt that it was impossible to plan for the development of such programs without knowledge of what currently existed throughout the state. As a result a small grant was made available from Sea Grant discretionary funds to provide time for a graduate assistant to examine the catalogs of all higher education institutions in the state. At the same time key administrators of each institution were asked to identify an individual who had responsibility for coordinating their marine and/or aquatic programs. The list of courses compiled from the catalogs was sent to this individual who was asked to verify its content as accurately representing that institution's course offerings. Over 500 courses were found that dealt with marine and/or aquatic topics as the major focus of the course. There were offerings by over 50 institutions. It was found that there were many courses dealing with biological and geological aspects of the marine and aquatic environments, but few if any were available in the arts, humanities or social sciences.

The results of this survey have been assembled into a Directory available through the education program office. It has been sent to individuals in each college and university in the state identified as a program leader in marine and aquatic programs in the survey. One function of the Directory will be to assist individuals in identifying courses available at other institutions, allowing students to develop a more specialized background without having to offer such courses at each university. In addition

it should serve as a guide to counselors in the state in advising high school students of programs at the various state institutions. It will also be used by the Ohio Sea Grant staff in determining needs for new courses and programs in marine and aquatic topics in the state, thus serving as a guide for future higher education efforts of the education program.

Several other developments sponsored by Sea Grant have occurred at the Ohio State University. A coastal engineering graduate program and a zoology course in oceanography have been developed with Sea Grant support. A cross-listed course in marine and aquatic education has also been established in Ohio State's College of Education and School of Natural Resources. This course responds to the demand for more content-oriented material usable by formal and nonformal educators.

Nonformal Education Efforts

With an informed citizenry as a goal, Sea Grant programs frequently prepare news releases and informational media programming for general adult audiences. Such efforts typically originate within advisory service and are done mostly as current events reporting or as announcements of advisory programs. A few resource organizations such as Wisconsin Sea Grant and the Ohio Department of Natural Resources have approached media programming on a regular basis as an educational tool.

Radio. As a research project within Ohio Sea Grant, many of the major concepts from OEAGLS were put into the form of one-minute radio programs developed by environmental communications students. These programs were aired on central Ohio radio stations over a one-month period and a telephone survey conducted to assess their effectiveness and the size of the general adult audience that was reached. The survey indicated low levels of knowledge about Lake Erie within the target group, but a desire to learn more (Fortner, 1981). Though the short broadcast period did not allow for high levels of measurable impact of the programs, the radio scripts and supporting literature have been used by advisory agents in subsequent program development. The level of audience interest encourages the belief that the general public as well as pre-college teachers and students may be receptive to Lake Erie information presented in short, attention-getting formats.

Museum Programming. Columbus' Center of Science and Industry (COSI) relies upon short, high-interest activities to provide educational experiences for its 300,000 visitors each year. During the summer of 1982, William C. Schmitt and his COSI Education Department used some Sea Grant funds and the content assistance of the Ohio Sea Grant Education Program staff to produce "The Great Lake Erie Treasure Hunt." The program consisted of six demonstration shows plus hands-on exhibits to inform audiences about the historic, scientific and recreational importance of Lake Erie as well as its geology, climate effects and wildlife.

COSI invites visitors to enjoy "The Great Lake Erie."

COSI judged the program to be the best summer show ever produced there, and visitor surveys done to evaluate the program's impact indicated significant increases in lake knowledge among the 46,000 summer visitors. Because of this success the program has been modified specifically for school audiences. The OEAGLS modules most closely related to the program topics are distributed to teachers who bring classes to COSI to attend the program. This mechanism therefore extends the use of OEAGLS and the awareness of teachers and the general public of the importance of Lake Erie and the education role of Ohio Sea Grant.

Visitors try water sampling at "The Great Lake Erie."

Television. An important finding of the baseline study conducted in 1979-80 was how students think they are getting their information about the oceans and Great Lakes. Movies and television are the most frequently reported information source (Fortner and Mayer, 1983).

The single experience shown to be most closely related to high knowledge scores was the number of Cousteau programs seen on television. When the Cousteau Society learned of this it agreed to cooperate in a research project testing the actual effectiveness of a television documentary in changing knowledge and attitudes on a marine topic.

With funding from The Ohio State University Small Grants Program and the Spencer Foundation, Dr. Fortner and a graduate student previewed an untelevised Cousteau Odyssey program, "Mammals of the Deep: The Warm Blooded Sea," and developed knowledge and attitude questions based on its content (Fortner and Lyon, 1982).

The questions were presented to two audiences, ninth graders at a suburban high school and adult cable television viewers, as a pretest, immediate posttest and delayed posttest. All the ninth graders responded to pencil and paper tests while the randomly selected adults responded interactively to televised tests using their home computer consoles from Warner Amex QUBE. Comparison groups in the school and a control group with QUBE took the tests but did not watch the documentary.

School testing provided information on television's effectiveness for marine education.

Scores of the test groups indicated significant gains in knowledge, with most of the information retained on the two-week delayed posttest. Attitudes on marine mammal issues were positive before the program and temporarily shifted to a more strongly positive position following the broadcast. It was also found that a teacher could produce the same kinds of effects in a standard classroom situation by teaching from the script of the broadcast. The television documentary, then, was an effective information source, but so was a skillful and well-informed teacher.

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APPENDIX A

Sample Pretest
Used in OEAGLS Development

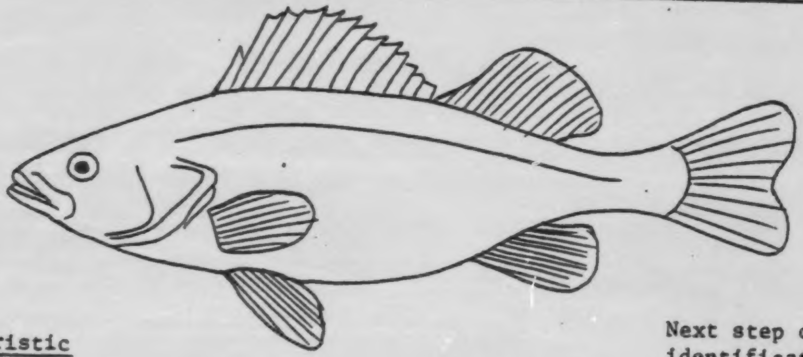
OCEANIC EDUCATION ACTIVITIES FOR GREAT LAKES STATES

PRETEST - Investigation # 24

Questions 1 through 3 contain words which could be used to describe the work which you do in class. Choose the number which best represents how you feel about the work that you have been doing. Record the number on the answer sheet.

1. Easy (1): (2): (3): (4): (5): Hard
2. Boring (1): (2): (3): (4): (5): Interesting
3. Clear (1): (2): (3): (4): (5): Confusing

The remaining questions in this test are about Ohio and/or Lake Erie. They deal with ideas that you will be discussing in class during the next few days. Since you probably have not covered this material, you are not expected to know all the answers. We want to find out how much you already know about these topics before you do the work in class. Please read each question carefully and decide which is the one best answer. Mark your answer on the separate sheet. If you do not know an answer, you may guess.



Characteristic	Next step or identification
1A. Lateral line	2
B. No lateral line	Sunfish
2A. Dorsal fins joined	Sculpin
B. Dorsal fins separate	3
3A. Rounded tail	Burbot
B. Forked tail	Yellow Perch

Questions 4-6 refer to the box above; turn the page to find the questions.

4. The material inside the box is called a

   a. crosslisting guide.
   b. dichotomous key.
   c. fish test.
   d. category chart.

5. Using the information in the box, you can

   a. identify the fish pictured.
   b. find out some characteristics of the fish pictured.
   c. find out some characteristics of all the fish named.
   d. do all of the above.

6. The name of the fish pictured in the box is

   a. Sunfish.
   b. Sculpin.
   c. Burbot.
   d. Yellow Perch.

7. Dorsal fins are found on a fish's

   a. underside.
   b. back.
   c. sides.
   d. ventral side.

8. A lateral line is a

   a. row of sense organs along the sides of some fish.
   b. dark stripe running all the way around a fish.
   c. line in a fin that helps make the fin stiff.
   c. mark that shows where the gills are located.

9. About how many families of fish live in Lake Erie?

   a. Thousands
   b. Hundreds
   c. 50
   d. 25-30

10. A parasitic fish found in Lake Erie is the

   a. sucker.
   b. lamprey.
   c. livebearer.
   d. sculpin.

11. An adipose fin is

   a. the ventral fin nearest a fish's tail.
   b. an extra fatty fin on the back of some fish.
   c. another name for the tail fin.
   d. the thick flap that covers the gills.

12. Barbels are sometimes found on a fish's

    a. head.
    b. tail.
    c. sides.
    d. back.

13. Which family of Lake Erie fish does not provide food for humans?

    a. Temperate Basses
    b. Trout/Salmon
    c. Herring
    d. Killifish

1[illegible]. Which family of Lake Erie fish is not commonly used as bait?

    a. Sunfish
    b. Silversides
    c. Sculpin
    d. Mudminnow

15. The common name of a fish may be based on

    a. what it looks like.
    b. where it lives.
    c. a sound it makes.
    d. any of the above.

APPENDIX B

Teacher Evaluation Forms
for OEAGLS Pilot Testing

OEAGLS EVALUATION PROGRAM

Instructions to the Teachers

PLEASE READ THE COMPLETE SET OF INSTRUCTIONS BEFORE BEGINNING TO WORK.

1. Assign a number from 1 to 9 to each class that works with the activity. Assign a number from 01 to 99 to each student in each class. Two students from different classes can have the same number. One possible way of assigning student numbers would be to write the student's name and number on the answer sheet and then have the students erase them when they are finished. You could also put the names and numbers on bits of paper and clip them to the answer sheets with paper clips. Please do not staple the answer sheets. You should keep a permanent record (possibly in your grade book) of the assigned numbers for reference. This number must be used on the student data register. The student's names are not to appear on any returned material. If a given class works with more than one activity, use the same class and student I.D. numbers for all activities. YOUR TEACHER I.D. NUMBER IS ________________.

2. There are two tests which must be given to the students working on the OEAGLS activities. Numbers 3-6 of the instructions identify the sequence in which these tests are to be written. Both must be answered on one answer sheet. Use the answer sheets provided, and have the students use soft lead pencils. The following number system has been set up for this purpose:

1-20	Activity Pre-Test
21-40	Activity Post-Test

   These tests may have less than 20 questions but the beginning numbers for the pre-test and the post-test will always be 1 and 21 respectively. When the students are taking the tests, tell them to be sure that the question number on the answer sheet corresponds to the question number on the test.

3. Completion of answer sheets.

   a) Before going to class, construct an identification number of the following form:

      -- Activity number as the first and second digits reading left to right.
      -- Teacher I.D. number as the third and fourth digits.
      -- Class I.D. number as the fifth digit. Class I.D. must be coded, even if you use only one class.
      -- For numbers less than 10 in a 2-digit field, code 01, 02, etc.

   b) Before handing out the answer sheets, instruct the students that they are not to write anything on the answer sheet except what you tell them to.

   c) Tell the students to turn the answer sheet sideways so that they can read the words at the top of it.

d) Write the identification number (see a above) on the chalkboard. Instruct your students to enter this number in the section on their answer sheets entitled SOCIAL SECURITY NUMBER. Tell them to use the first five spaces.

e) This number is followed by the student number in spaces 6 and 7. If their number is less than 10, tell them to write 01, 02, etc.

f) Once all the numbers have been written in the spaces, tell the students to use their pencils to blacken in the proper digits in the columns below them.

g) Have the students mark M or F under sex.

4. Give the Activity Pre-Test on the day before beginning to work on the activity. If possible, avoid giving it on a Friday. If this test is given on a Friday, please note this on the Activity Evaluation Form. The pre-test must begin at question 1 on the answer sheet. The information at the top of the answer sheet must be placed on all answer sheets.

5. Do the activity.

6. Give the Activity Post-Test on the day following the completion of the work with the activity. If possible, avoid giving these on a Monday. If they are given on a Monday, please note this on the Activity Evaluation Form. There are no time limits on the pre-test, or post-test. The pre-test and post-test will probably take about 15 minutes each. Be sure that students start the post-test in space 21 on the answer sheet.

7. Please check the answer sheets quickly to see that they were properly filled out. You should move about the class while the students are taking tests to make sure that they are placing their answers in the proper place. If you find answer sheets that have not been filled out properly, please make corrections where possible.

8. Fill out the Activity Evaluation Form.

9. If you have any questions about these procedures, contact Dr. Victor Mayer at (614) 422-4121. You may call collect, but when calling, please indicate that you are calling about the OEAGLS materials.

10. Return the following OEAGLS materials.

-- all activity booklets
-- all test booklets
-- all unused answer sheets
-- all used answer sheets
-- activity evaluation form
-- additional comments

1. Assign class and student I.D. numbers.
2. Construct an identification number containing activity number, teacher I.D., and class I.D.
3. Administer the Activity Pre-Test.
4. Do the activity.
5. Administer the Activity Post-Test.
6. Fill out the Activity Evaluation Form.
7. Return the materials.

N.B. The answer sheets are going to be machine scored. PLEASE HANDLE AND PACK THEM CAREFULLY. DO NOT FOLD, STAPLE OR MUTILATE THEM.

Activity Evaluation Form

1. Activity Number: ____________________
   Teacher I.D.: ______________________

   The questions in this form ask for your opinion concerning several aspects of the OEAGLS activity which you just taught. This information will help guide possible revisions of the activity.

2. How much class time, not including the testing, did you devote to this activity? Was it sufficient? Comment.

3. In the boxes provided below, give an estimate of the level of student involvement in this activity. Of all the students participating in the activity, what percentage were highly involved, moderately involved, etc.

	% of Students
High involvement	
Moderate involvement	
Indifference	
Moderate resistance	
Strong dislike	
Unable to rate	

4. Equipment: ☐ none needed ☐ easy to get
   ☐ unobtainable ☐ hard to get, (but I got it!)

5. Instructional level is: ☐ just right ☐ too childish ☐ too mature

   Additional comments:

6. Vocabulary level is: ☐ just right ☐ too easy ☐ too difficult, (Explain)

7. Was the teacher guide clear enough? ☐ Yes ☐ No, (Explain)

8. Did the activity fulfill the purpose stated in the teacher guide?
   ☐ Yes ☐ No, (Explain)

9. Did the students have difficulty with the activity? Yes ____ No ____
If so, with what. . .

a) understanding the objectives
b) following the directions
c) understanding the questions
d) other? (Explain)

10. Your rating of this activity:

☐ Worthwhile -- keep as is.

☐ Of value -- needs the revision suggested.

☐ Worth salvaging -- make major changes described.

☐ Worthless.

11. Feel free to make specific suggestions--what you think should be changed. Think of what you needed, what you had to work out for yourself. As a reminder of things, read through the following list before writing your comments (we know that we don't have everything listed!):

1. Organization of materials
2. Anything you added or changed
3. Problems with equipment, supplies, visual aids, etc.
4. Things that went wrong
5. What would you have done differently?
6. Any specific characteristics of students that were "turned on" or "turned off"
7. Evidence of learning or application of ideas
8. Creative modifications by students or teacher

Space for your comments (use additional sheets if necessary):

APPENDIX C

"Water Education Curriculum"
(Description of OEAGLS Evaluation)

CHAPTER SIX

THE WATER EDUCATION PROJECT

Original Proposal and First Year

In the mid-1970s, Richard Henry, a professor of science education at Middle University, completed his association with the Earth Science Project (ESP), a program designed to write supplementary materials for middle school science classes. Henry felt the type of materials produced by ESP, short modules consisting of two to three lessons organized around a common theme, were very appropriate for subject matter not typically a part of the middle science curriculum. Henry believed such an instructional design would also be pertinent for marine education materials, another curriculum area usually neglected in middle schools. Henry prepared a proposal for Sea Grant, a research and educational agency of the U.S. Department of Commerce that supported pre-collegiate curriculum development in marine education. Sea Grant approved the project and Henry began work on the Water Education Project (WEP) in 1977. (Interview notes)

The main purpose of Henry's project was "to improve student understanding of important concepts related to oceanic study that would be appropriate to interior regions of the United States." In the proposal, he wrote topics would "relate to water bodies such as the Great Lakes and the larger river systems," and be "appropriate for students in the middle school years." Henry listed fourteen broad type areas that would be covered in the project's materials:

1) Water recreation
2) Shipping and shipbuilding industries
3) Uses of water and the effect of water use
4) History of water transportation
5) Food resources of lakes and rivers
6) Evolution of lakes and rivers
7) Ecosystems of lakes and rivers
8) Lakes and rivers as political boundaries
9) Lakes and rivers as energy sources
10) Aesthetic and cultural resources of lakes and rivers
11) Mineral resources of lakes and rivers
12) Land and water management of lakes and rivers
13) Lakes and rivers as wilderness areas
14) Human geography of lakes and rivers

Each topic would be the focus in one or more activity packages consisting of one to three days of instruction for students. The activities would be usable by teachers "with a minimum of inservice preparation" and use equipment and materials that were "currently available to most teachers." A teacher guide would accompany each activity. (Project document)

Henry proposed that each topic would be developed by a three-person team, consisting of the principal investigator (Henry), a government, university or industrial expert on the topic, and a middle school teacher. The principal investigator and the middle school teacher would be responsible for the "development and informal classroom teaching of each activity (formative evaluation) and the 'topic expert' will check the accuracy of the material in the activity." (Project document)

Henry described the formative evaluation stage as "necessarily informal, using perhaps as many as three different classes chosen by the development team as being representative of the intended consumers of the activity." He listed three sources of evaluation information:

1. Pre- and post-tests of the cognitive objectives of the activity. These will be of the multiple-choice format. Item analysis information will be collected and items revised and improved and pre- and post-test forms developed. These items will ultimately be used in the summative evaluation.

2. Teacher-user feedback. This will take several forms:
   a) Marginal notes and comments of student and teacher materials.
   b) Completion of a 'Teacher Feedback' form.
   c) An audio-tape prepared by the teacher of his reactions and suggestions.

3. Observations of project personnel during trials of the materials.

4. Student feedback. This would consist of a standard form to which all students would respond with respect to interest level generated, difficulty of the activity, etc.

Revisions based on these data would be performed "as often as necessary until the development team is satisfied that the materials are effective for teaching the objectives intended." Henry envisioned producing 20 activities during the first year of the project and a total of 80 by the end of the proposed three-year development cycle. (Project document)

During the first year of the project, Henry organized an advisory panel to help generate specific activity topics from his general list and react to other ideas from Henry or cooperating classroom teachers. Henry selected teachers based on their work with him in previous projects and identified others from a series of workshops he was presenting on marine education. Development work was begun on six topics, most involving the geography, hydrology, and meteorology of the Great Lakes. (Interview notes; Project publication)

During this period, the development and evaluation procedures that Henry authored in his proposal were implemented and only slightly modified. The formative evaluation instruments proved useful. The team approach to the development and testing of the materials worked well, although the subject matter expert did not participate until after the activity had been written and tested. However, rather than describing these first-year activities in detail when Henry served as the sole director of the project, the narrative will instead focus on the period 1978 to 1980 when Henry was joined by Marilyn Simpson as co-director. The development routine Henry established during the first year remained intact in later years and development activities after Simpson arrived differed only in that Henry now had a permanent associate to share ideas and critique lessons. Other reasons for concentrating on this later period include the fact that nearly 75% of the activities were completed after Simpson arrived, and both developers considered the Water Education Project a team venture.

Building a Working Relationship

Simpson's faculty assignment at Middle University was to split her time 50-50 between teaching education courses and writing for the Water Education Project. Her previous development experience was limited to some work she had done for her own junior high teaching and school districts in another state. None had involved systematic field-testing or formative evaluation, and she judged WEP to be "considerably more sophisticated" than her earlier work. (Interview notes)

Simpson clearly looked to Henry to provide the direction on the team. He was a full professor with considerable experience in curriculum development and evaluation had designed this project, and already had one year of experience in preparing the materials. Henry remembered that, if anything, Simpson was too deferential. "The first year she was less critical and tended to take my suggestions as requirements. But then she learned better," Henry said. As Simpson became familiar with the project's routine and gained experience in writing materials and organizing field-tests, their relationship evolved into more of an equal partnership. (Interview notes)

Each took full responsibility for certain topics and guided the development of the lesson activities. Simpson noted that each activity listed one of them as an author, but the other "passed clearance" on all content. "We brought different skills into the project. I have a way of writing that is very precise and clear in the form of giving instructions. Dick's strength is in the pedagogical model; he is very creative, very open to new things." The two worked in offices directly across a hallway and met informally nearly every day to discuss new ideas, report on classroom observations, and react to earlier lessons.

Writing Lessons

Activities were either developed from the ideas of Henry and Simpson or were based on teacher-developed lessons. The activities begun by the co-directors came from Henry's original list of topics in the proposal, suggestions from the advisory committee, or ideas in books, articles, or scientific reports. Simpson's idea for the first lesson she developed came from a popular song, "The Wreck of the Edmund Fitzgerald," about a shipwreck on the Great Lakes. She had always liked the song ("From the first time I heard it, I thought this was a teachable moment"), and the content focus of the project allowed her to develop her interest into a full-blown instructional activity on the "Great Lakes Triangle", an area with supposedly mysterious forces, a la the "Bermuda Triangle." (Interview notes)

They also developed an initial list of objectives to guide their first draft based on the answers to the questions of "What do we want to teach?" and "What do we want kids to learn?" Henry didn't find strict behavioral objectives useful ("Their value doesn't outweigh the amount of sweat it takes to write them"), and usually found it difficult "to identify objectives when we wrote them in the cycle at an early spot." But Henry felt that objectives helped identify "really vital, crucial learning points," and listing them gave the writing specific direction and provided the basis for the pre- and post-tests that accompanied each set of activities. "By the time you finsihed a first draft, you'd have the objectives. There were some minor changes in them after the pilot so they could be more precise and better reflect the nature of the activity." (Interview notes)

After completing the first draft, the author would submit it to the other co-director for review. Simpson said she critiqued these early drafts on the "basis of experience and background." She would estimate the length of time required for the activity to determine if it was too long for middle school students. Another concern for both Henry and Simpson was that activities not demand special classroom equipment or require logistical arrangements (such as field trips) that would make them difficult to implement. (Interview notes)

If an activity was to undergo major changes during its development, those changes were likely to come during these initial brainstorming and review sessions. Simpson believed, "Our internal collaboration was responsible for the most substantial changes. After we got into the field, the changes were mostly format changes or logistic changes. We couldn't anticipate timing and logistical problems in the review process. Dick and I tried, but we couldn't always do that, but classroom observation helped us there." Despite these limitations, Simpson estimated that most of the "substantive" changes occurred during the internal review sessions before the materials went to the field trial. (Interview notes)

Henry agreed. "Once we developed an activity, the basic structure stayed pretty much the same. I don't reminder that we ever threw an idea out. We made minor changes explicating the activity better." Henry felt part of the reason for this was due to the fairly fast, consistent pace of development. He and Simpson typically had three or four modules in development at one time at different points in the cycle. The time restrictions and the modest funding for the project meant that once the general outline of an activity was set, the authors did not have the opportunities for large-scale revisions. Henry described these restrictions on the scope of revisions as "blinders." "You develop blinders in a sense, but that's OK. Brainstorming, reviewing, reworking is expensive. By and large, I don't think that's effective. What we've done on a modest scale is every bit as effective. We produced as much with this project as did ESP (the Earth Science Project) with ten times more money. Blinders can be helpful, economical, keep you on track." (Interview notes)

When the activity reached a point where the content was well-established, the primary author would arrange with a middle school teacher to serve as co-developer and pilot-teacher of the module. The teacher often began the process of preparing items for the pre- and post-tests. However, both Henry and Simpson would review these questions and usually write several items themselves. (Interview notes)

A second approach to the preparation of an activity began with an idea developed by a teacher. The co-director identified these teachers through their masters-level courses at the university, inservice workshops, and Henry's contacts with teachers in the public schools. Teachers wrote up their ideas and submitted them to Henry or Simpson. Some teachers remained involved in the development process as Henry or Simpson reworked the original idea. Other teachers were not asked to participate in the revision process or chose not to be involved. (Interview notes)

Henry and Simpson approached the teacher-developed activities with the same criteria they used to judge their own lessons. In addition, they were concerned with revising lessons to make them usable for other teachers. In many cases, the original lesson was too narrowly written and not generalizable beyond the teacher-author's classroom. Lessons also had to be reduced in length and updated to account for recent research findings. (Interview notes)

Typically, Simpson and Henry did not use the original author as the pilot-teacher of the lessons. They believed it was essential to test the activities in another setting in order to determine their success. Simpson said, "The materials were written to stand alone and by testing them in the author's classroom, we wouldn't find that out." These pilot-teachers, however, were not considered co-authors. (Interview notes)

Field Tests

In his original proposal, Henry anticipated involving "as many as three different classes" representative of the intended users of the activities in the field-tests. In practice, the developers did use three to four classrooms, but typically they were all taught by the same teacher in the same school. Thus, each activity was tested by 100 students or more. (Project document; Interview notes)

Pilot teachers received a pre- and post-test assessing the content of the activities. Each test contained approximataly 10 multiple choice items, and unless an item-analysis of the pre-test indicated major problems with an item, the pre- and post-tests were identical. These tests also contained three Likert scale items measuring students' opinion of the material's difficulty, clarity, and interest. (See Figure 7) Teachers also received an "Activity Evaluation Form," which asked them to rate the material's difficulty and interest, and the clarity of the teacher's guide. (See Figure 8) In addition to the data collected from the forms, Henry or Simpson observed each pilot-teacher on at least one occasion. Thus, the data collected from each field test included pre- and post-tests, questionnaires, and observations (Project document; Interview notes)

The developers felt each of these data sources provided useful information. But the glue holding the data together cane from their participation with the complete evaluation process, especially their first-hand contact with the pilot classrooms. (Interview notes)

Simpson was firm in her belief that developers also had to be evaluators:

> I would always do evaluations myself. You do curriculum development not just as a function to produce a product. You do development because you believe something needs to be taught. Developers have to ascertain personally that they do that. They see the light in the kids' eyes.

The project never considered an outside evaluator, but Simpson would have vetoed the idea anyway. An outside evaluator would not have shared their "commitment" or "zeal" and would not have been as aware of critical facets of the program as were she and Henry. Simpson argued,

> Even though somebody else would have been objective and gone through the evaluation steps one-two-three-four, the thought processes and background and sense of urgency of getting the job done right would not have been there. I have a feeling--no, I know--you learn better by experience, and if I were to hear a report or see a written report, it wouldn't do the same thing for me. Knowing the kinds of affective results we were looking for, I can see more observing the classroom process directly. (Interview notes)

Henry shared Simpson's commitment to the "developer-evaluator" role and the need to be immersed in classroom activities. He compared the field-testing procedures in the Water Education Project with the larger Earth Science Project (ESP).

> ESP was a nationwide expensive test. Pilot-teachers were representative, but the feedback we got from our own small group was no different in terms of quality or being useful. I lost confidence in the need for large-scale field tests. You must have a developer-evaluator who works in schools in a daily, regular basis. We know teachers; we supervise student teachers; we're out in the field a lot, and we know what kids can do. Some of these activities we did the piloting ourselves. If you have that characteristic, knowledge of a classroom, a developer can select teachers who can help you and develop the activity to generalize it. It also gives you the confidence to write good materials and make changes.

Henry's and Simpson's reliance on personal knowledge of the evaluation procedures and classrooms to help understand and interpret field-test results should not mask their use of the other data they collected. Simpson thought the test items were most useful in a confirming role, "assuring us the content was coming through." Henry found the test scores "sensitized" him to problem areas, especially in terms of content acquisition. However, the test results didn't necessarily explain why the problem was there. Once the item analysis gave him confidence in the item, Henry would next "relate the test items to objectives" and look generally at the materials to see if he could uncover a weakness in the instruction aimed at teaching that particular objective. Henry explained," Maybe the reading level is too high. Maybe the activity didn't focus on the objective, it just missed the mark. You look at the teacher's guide. Maybe this is where the change has got to be made. You rely on observations. Classroom visits can flush out things not on the test. Somehow or another you ask does the activity handle the objective?" (Interview notes)

The teacher forms and comments were also valuable for Henry, especially in making procedures more generalizable. Teachers asked for "more information and better, clearer directions." Simpson recalled that teachers provided useful information about the extent of student involvement across an entire class. They also reported on the availability of the materials and the ease of implementing the activities. Simpson recalled making changes in some lessons based on teacher comments that procedures or logistics were cumbersome. (Interview notes)

Having just one pilot-teacher per activity did pose some data interpretation problems for Henry and Simpson. Henry recalled the pilot of a weather activity occurred in a "rather chaotic classroom, and so we weren't really sure how well the activity was doing." Simpson felt that in several trial classrooms the pilot-teacher represented, to some extent, an optimum user and not a typical teacher. But Simpson continually compared the performance of the pilot-teacher to her knowledge of other teachers and her own teaching experience in order to judge whether the materials would work in different settings. She did not expect the materials to be suitable for all teachers. "You know intuitively there are teachers who will never use these materials. The only thing that will change their routine is a school assembly." But the reliance on her experience and contact with teachers in WEP workshop settings helped convince Simpson that the materials could be used successfully beyond the pilot classrooms.

Post-Pilot Revisions

Generally, the activities did not undergo major changes after the pilot-testing. Henry remembered that by this time "the basic sequence of the activity was set." A pilot-teacher and co-author of an activity, Elaine Bright, agreed with Henry's assessment. "The pilot versions and final copy of the activities I participated in were basically the same." Bright saw more substantive changes between her original lesson (that she submitted for a Henry workshop) and the pilot version produced by Henry than between the pilot and the final copy. (Interview notes)

Simpson recalled revisions that provided more explanation and background for teachers and, in some instances, furnished additional content information for students. Question sequences in the student booklets were revised, teacher guide instructions improved, and in a few activities, entire lessons were "scrapped." (Interview notes)

Simpson's changes in her "Great Lakes Triangle" activity were typical of the scope of revisions and illustrated how evaluation data contributed to the process. In the original lesson students had to complete three activities, including designing a Great Lakes ship, forecasting and tracking storms, and mapping characteristics of lake bottoms. During the field test, Simpson observed that these three activities took too long and that the students finished at different times. She revised the activities to make them equal in length and rewrote the teacher's guide instructions to create three groups of students, each required to complete only one of the activities. (Interview notes; Project publication)

A second problem involved an activity in which students plotted the location of nearly 50 ship and plane disappearances in the Great Lakes area.

Simpson's observations of the field-test showed that this activity also took too much time and was too difficult. "Either the kids couldn't do it, or do it quickly enough. Watching them struggle with it, I knew it wasn't going to work." In the final version, the disappearances were printed on the map. (Interview notes; Project publication)

Henry and Simpson worked separately on their own topics, but they continued to exchange information and ideas. They each did the final editing of the other's materials. The teacher-author typically was not involved in the revision process. (Interview notes)

The revision process involved sifting through a considerable pile of data. Student workbooks were collected after each field test to assess the reading level. Students had been asked to circle each word they didn't understand. The student test pages and teacher questionnaire forms provided cues for certain changes. "One hundred forms," remembered Simpson, "and we went through every one of them trying to see where kids broke down. But we couldn't have figured it out if we hadn't been there." (Interview notes)

Some data they ignored. Simpson recalled this happened infrequently, but in a few activities when the teacher comments or the student data indicated a problem with something "crucial to the rest of the lesson," it was retained in spite of the results. Henry remembered that if there was a conflict between what he and a pilot teacher thought was appropriate, he placed his emphasis on his own experience and judgment. In a simulation game on the War of 1812 originally developed by a teacher-author, Henry felt the activity was too complex. He cut one-half the role cards and changed some of the game mechanics to shorten the teaching time. But, "the teacher wanted more role cards. It took her three weeks to do the lesson. I couldn't see other teachers taking that long." Henry wanted to do further revisions, but "it was good enough as it was, and needed to get out." (Interview notes)

After the instructional sequence was settled and content finalized, the final step in the revision process involved content reviewers. Henry generally selected reviewers from the university community who had worked with him on previous projects. As it turned out, the main contribution of the reviewers was to confirm the accuracy of the content, rather than suggest major changes. "We never had any major problems in terms of rewriting," said Henry. He modified a geography activity based on outside reviews, a sentence here, a sentence there." Other suggestions included specifying more recent data or different graphics. (Interview notes)

Each final activity included a student booklet and a teacher's guide. The materials were published by the Sea Grant Office of Middle University and generally distributed to teachers at workshops. As new activities were written, they were placed in publication. By 1980, the final year of development, 23 activities had been completed. (See Figure 9) "Not every activity is exciting, innovative and dynamic," said Henry. "Some we didn't like very well, and some we didn't get wildly enthusiastic reviews on, but all of them are good. Teachers are using them because they are better than anything else." (Interview notes)

This assessment was not a criticism of the evaluation methods the project employed. Both Henry and Simpson felt their use of different data sources was a valuable decision. Henry said, "You have to do different kinds of review. You have to have feedback from kids. I would like to have had more pilot-teachers, but I doubt it would have changed the results much." Simpson would design a similar formative evaluation component for her next project. "It was very valuable. Very time-consuming. I tell my students now what all we did, and they can't believe it. They say they'll never get done on time. I tell them 'you'll never get a good product if you don't.'"

FIGURE 7: Sample Pre-test

PRETEST - Investigation #12

Questions 1 through 3 contain words which could be used to describe the work which you do in class. Choose the number which best represents how you feel about the work that you have been doing. Record the number on thà answer sheet.

1. Easy (1): (2): (3): (4): (5): Hard
2. Boring (1): (2): (3): (4): (5): Interesting
3. Clear (1): (2): (3): (4): (5): Confusing

The remaining questions in this test are about Ohio and/or Lake Erie. They deal with ideas that you will be discussing in class during the next few days. Since you probably have not covered this material, you are not expected to know all the answers. We want to find out how much you already know about these topics before you do the work in class. Please read each question carefully and decide which is the one best answer. Mark your answer on the separate sheet. If you do not know an answer, you may guess.

4. The Great Lakes are
    1. mildy involved with international shipping.
    2. not involved with international shipping.
    3. very much involved with international shipping.
    4. involved only with shipping from one lake to another.
5. The flag always flown on a commercial ship shows
    1. where the ship unloads its cargo.
    2. where the ship picks up cargo.
    3. in what country that ship is registered.
6. The major type of cargo shipped to the Port of Toledo is
    1. food stuffs.
    2. manufactured goods.
    3. miscellaneous goods.
    4. raw materials for industry.
7. From the Port of Toledo, the products that are shipped are chiefly
    1. food stuffs.
    2. manufactured goods.
    3. miscellaneous goods.
    4. raw materials for industry.

8. What foreign continent provides most of the trade at the Port of Toledo?
    1. Africa
    2. South/Central America
    3. Asia
    4. Europe
9. Through the Port of Toledo,
    1. more ships import products than export them.
    2. more ships export products than import them.
    3. the number of ships used to import and export are equal.
    4. only ships exporting products are allowed to use the Port of Toledo.
10. Even though Lake Superior is 600 feet above the level of the sea, it is still used by ocean going ships. These ships reach this 600 ft. level by means of which of the following?
    1. elevators
    2. dikes
    3. locks
    4. water ladders
11. Water to fill the lock chamber comes from what source?
    1. Through the valves that open to the lower level.
    2. Through the valves that open to the upper level.
    3. Through water pumps.
    4. Through the gates that allow the ships in and out.
12. After a ship enters the lock chamber from the upper level and the gates are closed, which of the following happens to get the boat down to the lower level?.
    1. The exit gates are opened, allowing the water to rush out.
    2. The water is pumped out through drainage hoses.
    3. The emptyingvalve is opened, allowing the water to seek its own level.
    4. The lock chamber is lowered mechanically until the water level in the lock equals the lower level.
13. Registry flags of different countries are flown on some ships even though the ships aren't from those countries. This is done to save money on taxes. These flags are called
    1. flags of proposal.
    2. flags of convenience.
    3. flags of trade.
    4. flags of international regulation.
14. The annual shipping season in the Great Lakes closes down when:
    1. the grain elevators along Lake Erie and Lake Ontario close.
    2. the steel mills in Youngstown, Gary and Pittsburghshut down.
    3. ice closes the shipping lanes and locks.
    4. the workmen aboard the ships take their annual leave.

FIGURE 8: Teacher Questionnaire Form

1. Activity Number: ______________
   Teacher I.D.: ______________

   The questions in this form ask for your opinion concerning several aspects of the **WEP** activity which you just taught. This information will help guide possible revisions of the activity.

2. How much class time, not including the testing, did you devote to this activity? Was it sufficient? Comment.

3. In the boxes provided below, give an estimate of the level of student involvement in this activity. Of all the students participating in the activity, what percentage were highly involved, moderately involved, etc.

	% of Students
High involvement	
Moderate involvement	
Indifference	
Moderate resistance	
Strong dislike	
Unable to rate	

4. Equipment: ☐ none needed ☐ easy to get
   ☐ unobtainable ☐ hard to get, (but I got it!)

5. Instructional level is: ☐ just right ☐ too childish ☐ too mature
   Additional comments:

6. Vocabulary level is: ☐ just right ☐ too easy ☐ too difficult, (Explain)

7. Was the teacher guide clear enough? ☐ Yes ☐ No, (Explain)

8. Did the activity fulfill the purpose stated in the teacher guide?
   ☐ Yes ☐ No, (Explain)

9. Did the students have difficulty with the activity? Yes ___ No ___
   If so, with what. . .

   a) understanding the objectives
   b) following the directions
   c) understanding the questions
   d) other? (Explain)

10. Your rating of this activity:

    ☐ Worthwhile -- keep as is.
    ☐ Of value -- needs the revision suggested.
    ☐ Worth salvaging -- make major changes described.
    ☐ Worthless.

11. Feel free to make specific suggestions--what you think should be changed. Think of what you needed, what you had to work out for yourself. As a reminder of things, read through the following list before writing your comments (we know that we don't have everything listed!):

    1. Organization of materials
    2. Anything you added or changed
    3. Problems with equipment, supplies, visual aids, etc.
    4. Things that went wrong
    5. What would you have done differently?
    6. Any specific characteristics of students that were "turned on" or "turned off"
    7. Evidence of learning or application of ideas
    8. Creative modifications by students or teacher

    Space for your comments (use additional sheets if necessary):

FIGURE 9

Final List of Project Activities

---

1. The Effect of Lake Erie on Ohio's Temperature
2. The Effect of Lake Erie on Climate
3. Ancient Shores of Lake Erie
4. How to Protect a River
5. Lake Erie and Changing Lake Levels
6. Erosion Along Lake Erie
7. Coastal Processes and Erosion
8. Pollution in Lake Erie: An Introduction
9. Yellow Perch in Lake Erie
10. Evidence of Ancient Seas in Ohio
11. To Harvest a Walleye
12. Oil Spill!
13. Shipping on the Great Lakes
14. Geography of the Great Lakes
15. Ohio Canals
16. The Estuary: A Special Place
17. The Great Lakes Triangle
18. Knowing the Ropes
19. Getting to Know Your Local Fish
20. Shipping: The World Connection
21. We Have Met the Enemy
22. It's Everyone's Sea: Or Is It?
23. PCBs in Fish: A Problem?

APPENDIX D

Middle Sea

Ohio Sea Grant

Middle Sea

SEA GRANT INFORMATION FOR OHIO EDUCATORS

VOLUME 3, NUMBER 2

WINTER 1981

MAKING WAVES WITH WORKSHOPS

January was a busy and exciting month for the Ohio Sea Grant Education Program. Two components of our Awareness and Implementation Project swung into action, and a five-state cooperative program for Great Lakes education was begun. All these activities are described in this issue, along with their implications for the future of marine and aquatic education in Ohio.

GREAT LAKES SEA GRANT NETWORK

The Ohio Sea Grant Education Program hosted a meeting of the five-state Great Lakes Sea Grant Network education program, January 21-23. Involved were Sea Grant representatives and the Marine Education Coordinators from the state departments of education from the states of Minnesota, Wisconsin, Michigan, Ohio and New York. Representatives from each of the states described their Sea Grant education programs and educational materials.

Dr. Paul Novak, Michigan Sea Grant, describes curriculum materials dealing with the sea lamprey.

The major objective of the meeting was to identify areas and programs where cooperative efforts between the states could facilitate the development of marine and aquatic education programs. One of the major results of the conference was a commitment from each state group to develop a state plan for marine and aquatic education. In addition a network plan will be developed that will identify areas of possible cooperation and mechanisms to be used by the network to facilitate the work of each of the state groups.

LOCAL TEACHER WORKSHOP

The Awareness and Implementation Project is committed to the establishment of a one-credit workshop for teachers, to be offered in ten areas of the state each year for the next two years. This year's goal is to identify the best format for that workshop by testing the model in two areas of the state.

Kon-Tiki materials from Project COAST are explored by workshop participants.

On January 28 and 29, twenty teachers from central Ohio met at the FUSE Center at Capital University in Columbus. After an evening of learning about the need for marine and aquatic education and exploring a series of learning centers on various topics, the enthusiastic group of teachers spent a full day trying out activities in science, social studies and humanities of the seas and Great Lakes. Curriculum projects from all over the country were introduced, and teachers were encouraged to develop their own activities based on the models they had observed.

Reactions to the workshop were overwhelmingly positive, so plans are being made now for the second one to be held in the Toledo area on April 8-9. If you are a teacher in that area in grades 5-9, any subject, you are invited to apply for this no-cost workshop. Contact Dr. John Hug, Ohio Department of Education, 65 S. Front Street, Columbus, OH 43215.

Teachers locate ancient shores of Lake Erie using OEAGLS materials.

LEADERSHIP SEMINAR

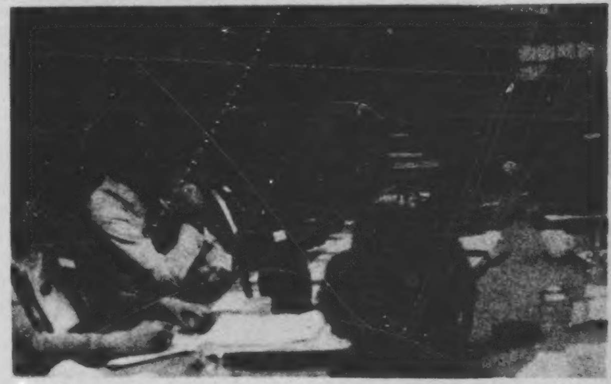
The third effort in January is described in the next article by student Marty Schmidt.

In all, the three January meetings left us exhausted, exhilarated and renewed in our conviction that many educators share our feelings about the need for increased emphasis on the World of Water in education. Our strength grows as our members increase, and we rely upon our new acquaintances to help in this exciting mission.

Marinating Ohio Schools

Like salmon battling river currents to reach a destination upstream, some Ohio educators are striving to make marine education an acceptable part of Ohio's school curriculum. Fourteen professionals from across the state met January 15 in Columbus, hoping to spawn new ideas for making water education a reality in the state's classrooms. The Marine and Aquatic Education Project State Leadership Seminar, co-sponsored by the Ohio Department of Education and Ohio Sea Grant, included presentations by Dr. John Hug, Ohio Marine Education Coordinator; Dr. Vic Mayer, Director of the Ohio Sea Grant Education Program; and Dr. Rosanne Fortner, editor of Middle Sea.

Those who attended the seminar included classroom teachers, school administrators, teacher educators and teachers in informal settings. These participants were invited as representative educators with a deep commitment to bringing marine and aquatic education to Ohio schools.



Leadership seminar participants brainstorm ideas for furthering marine and aquatic education in Ohio.

WHAT NEEDS TO BE DONE

The need for such education seems clear. Dr. Fortner's review of her 1979 survey reminded participants that 54% of the fifth graders and 40% of the ninth graders sampled in Ohio could not correctly identify Lake Erie on a map of the Great Lakes. Overall knowledge scores on water-related topics were 38% in the fifth grade and 48% in the ninth. Addressing this need requires the cooperation and coordination of educators.

The development of marine and aquatic education doesn't mean adding new programs to curricula or new work to overworked teachers. It is simply integrating information into what's already there. The key to its success is to have information and materials easily accessible to teachers and librarians and to make those materials easy to use in a variety of classes and environments. Aquatic education encompasses a school of subjects--from history, transportation and recreation, to weather, music and literature.

WHAT WE HAVE

An overview of the types and sources of marine and aquatic curriculum materials and educational programs reveals a wide variety of resources for interdisciplinary education. The OEAGLS project of Ohio Sea Grant now has 23 modules covering interdisciplinary topics. They contain short, complete activities, providing necessary background information and requiring little preparation time for the teacher.

"Oil spill" learning center attracts the attention of John Hug, author Marty Schmidt and Adelia Peters.

Materials are also available from other Sea Grant Programs, curriculum development projects and creative individual teachers. Through the National Marine Education Association, Ohio Sea Grant has access to information on existing resources and new materials as they become available.

WHERE DO WE GO FROM HERE?

Seminar participants "drained their brains" to explore new ways of encouraging teachers to utilize the available materials. Some new tacks were suggested to help educators to take the plunge. As these creative ideas are implemented, Middle Sea will report plans, progress and results. It is expected that these educational leaders can have a significant impact on the state in encouraging marine and aquatic education.

Participants left the seminar with buoyant spirits, hoping to sponsor more leadership workshops in the future. The energy and creativity of dedicated people across the state is necessary to insure that the future of the Great Lakes is anchored securely in a well-informed and responsible citizenry.

Martha A. Schmidt
OSU Environmental
Communications

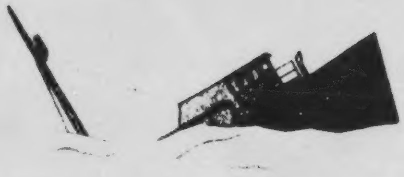
WE CARE ABOUT OCEANS — Wildlife Week 1981

Each year the National Wildlife Federation sponsors Wildlife Week, a special observance focusing on a natural resource. This year the theme for Wildlife Week, March 15-29, is "We Care about Oceans."

Why not plan to include more marine and aquatic information in your teaching in preparation for this special week? Perhaps your school would be interested in putting on a Sea-Fair, with each class doing a project. Let your imagination be your guide, but don't let this opportunity pass. Call attention to the current ocean and Great Lakes issues and the importance of using our water resources wisely.

National Wildlife will provide a free poster and Wildlife Week activity guide for interested teachers. Send a postcard with your name and address to:

National Wildlife Federation
Wildlife Week, NWP81
1412 16th Street, NW
Washington, DC 20036



That Sinking Feeling

Lake Erie has not only gained international importance in industry, transportation and recreation, some now claim that it ranks among the most dangerous and mysterious places in the world. Lake Erie is included in a hypothetical boundary that encompasses all the Great Lakes and some surrounding areas. The region within this boundary is known as the Great Lakes Triangle.

The Great Lakes Triangle is only one-sixteenth the size of the Bermuda Triangle yet is responsible for as many wrecks. Since 1770 Lake Erie alone has claimed 380 ships, all of which were over 45 feet in length. Twenty-one of the ships left no trace, and in many other cases only a few scraps were found.

Not only ships but planes have suddenly disappeared within the triangle. In fact, Jay Gourley's book, The Great Lakes Triangle, documents thirty-nine airplanes that have gone down without a trace and for no apparent reason. These planes ranged from the smallest Cessna to an airliner carrying 58 passengers.

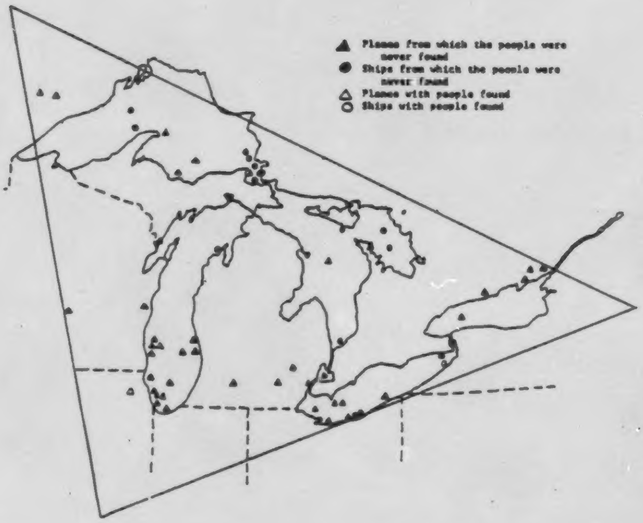
Bad weather cannot be blamed for the mysterious loss of all of these boats and planes. For example, on April 4, 1979, a 727 jetliner flying from New York to Minneapolis in clear weather began to vibrate and went into a barrel roll. The plane dove five miles at speeds exceeding that of sound. The only injuries suffered were emotional ones. Never before had a commercial airliner survived such an ordeal. Although reasons for the strange occurrence were investigated, no specific cause was ever determined.

From the optimist's point of view the 380 vessels which litter Lake Erie have attracted inquisitive scuba divers to the area. Interest in investigating shipwrecks has grown to such proportions that underwater parks in Lake Erie have been proposed. Lake Huron already has Fathom Five Provincial Park at Tobermory, Ontario, with explorable wrecks dating back to 1897. But if you have visions of getting rich from the cargoes of the ships, it will be to your advantage to know that most of them were carrying cargoes of coal, iron ore or grain.

The Ohio Sea Grant Education Program has developed an instructional activity in which students investigate the possible scientific reasons for disappearances within the Great Lakes Triangle. The investigation has the students study storm tracking, lake bottoms and a scale model of a bulk carrier, the *Edmund Fitzgerald*, which went down in a 1975 storm on Lake Superior. The activity may be ordered using the form on page **9**.

Most of the occurrences in the Great Lakes triangle have logical explanations. Some, however, have not been completely explained.

Erik J. Buggé
OSU Environmental Communications


▲ Planes from which the people were never found
● Ships from which the people were never found
△ Planes with people found
○ Ships with people found

Estimated locations of disappearances described in Gourley's The Great Lakes Triangle

Summer Schooling

Ohio Sea Grant Education is planning a marine and aquatic education seminar for teachers to be conducted in the Cleveland area this summer. Present plans are tentative but call for an intensive 5-credit workshop meeting for 10 days in mid-July. Participants will be given opportunities to use education materials developed by Ohio Sea Grant (OEAGLS), Michigan Sea Grant and other agencies. Several field trips are planned to lake side features and industries. The workshop is intended for teachers of grades five through nine and for all subject areas, especially social studies, language arts, science and mathematics.

Plans are also being explored for a three-credit Natural Resources workshop designed for 4-H leaders, extension and advisory agents in the Cleveland area this summer. The course will illustrate how to use local resources and adapt school curriculum materials to teach young people about the Great Lakes and oceans in informal settings.

For information about either of these workshops, write to the address below. Please specify whether your interest is in the Teacher Seminar or the 4-H/ Extension Workshop.

Summer Courses
Ohio Sea Grant Education Office
249 Arps Hall
1945 N. High Street
Columbus, Ohio 43210

Iceland is geologically one of the most important and interesting places on earth. Because of the country's location astride the Mid-Atlantic Ridge, it affords a unique opportunity to study a mid-ocean ridge where the earth's crust is actively rifting apart. Iceland is also the site of widespread, active volcanism and glaciation, and is one of the best places in the world for studying the interaction of these two phenomena.

The University of Northern Colorado is offering a course, Geology of Iceland, from July 25 to August 15, 1981, the purpose of which is to provide participants with opportunities for in-depth, on-site study of Iceland's many outstanding geological features. Ten quarter hours of graduate or undergraduate credit may be earned by course participants; and the only prerequisites are one introductory geology course and a desire to participate in one of the greatest learning adventures of your life. The approximate cost of the 1981 Geologic Field Study in Iceland will be $2850, which includes tuition, and all expenses connected with the tour. For more information write or call Dr. K. Lee Shropshire, Department of Earth Sciences, University of Northern Colorado, Greeley, Colorado 80639 (Phone: 303/351-2285 or 351-2647).

small fry

Mrs. Diane Cantrell, introduced in the fall issue as coordinator of the Awareness and Implementation project for Ohio Sea Grant's Education Program did an outstanding job of organizing the leadership seminar and pilot workshop that are described in this issue. Because of her own development project, however, she was unable to attend those meetings to accept the kudos. On January 18, Diane gave birth to her first child, Erika Tyne. Our congratulations to the Cantrells and our thanks to Diane for her fine work with our program.

Wetlands Activity

from Bowman, M. L. and J. F. Disinger, Land Use Activities for the Classroom, ERIC/SMEAC, 1977.

PURPOSE: To understand how development of wetlands increases probability of flooding downstream.

LEVEL: 10-12

SUBJECT: Science
Mathematics
Social Studies

CONCEPT: Natural resources are unequally distributed with respect to land areas and political boundaries thus, conflicts emerge between private land use rights and the maintenance of environmental quality for the general public.

REFERENCE: Inland Wetlands, Area Cooperative Educational Services, New Haven, CT, Environmental Education Center. ED 133 219.

ACTIVITY: When wetlands are used for the development of industrial sites or shopping centers, arrangements must be made to handle the run off that occurs during rain storms. Wetlands have the ability to store large quantities of water, on the other hand, impervious surfaces generate large quantities of storm water run off. To illustrate this point, study the following problem.

SCENARIO: You have a parcel of marginal wetland that has [illegible] feet of frontage on a major highway and is 1,099 feet deep. A development group has made an attractive offer for the property, with the intent of filling the area and building a shopping center on the site.

Neighbors downstream for the site have expressed concern about the flooding of a small stream that runs across the back of the property.

TASK: Calculate the gallons of run off created during a two-inch rainfall if the parcel is covered by an impervious surface (i.e., parking lot and buildings).

PROCEDURE: (To calculate cubic feet of water we must multiply length of site in feet X width of site in feet X depth of water in feet).

1. Calculate the square footage of the area:
   1,009 feet X 800 feet = 871,200 sq. ft.

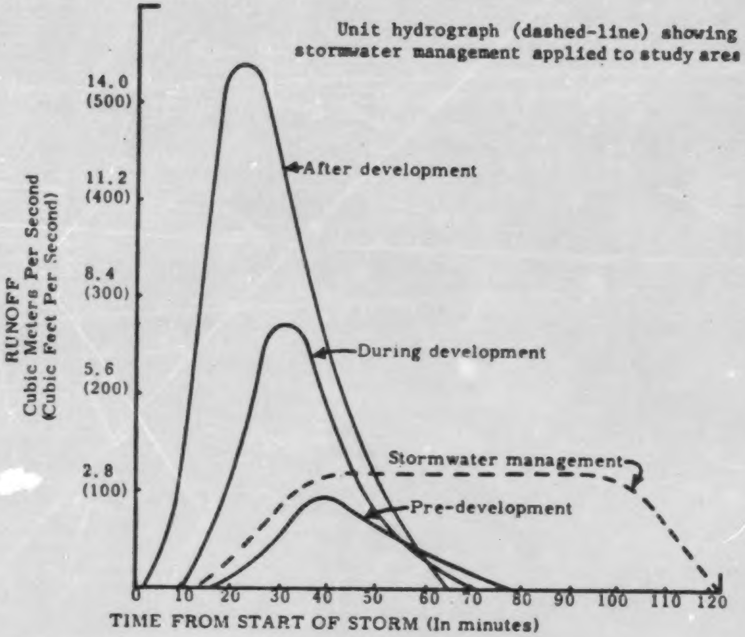
2. Convert 2 inches of rainfall to a fraction of one foot:
   2 inches/12 inches = 1/6 of a foot of rain.

3. To calculate the number of cubic feet of run off from this area, multiply:
   871,200 sq. ft. X 1/6 ft. of rain = 145,200 cu. ft. of run off.

4. One cubic foot of water = 7.48 gallons, so to convert 145,200 cu. ft. to gallons we must multiply by 7.48 gallons per cubic foot. 145,200 cu. ft. x 7.48 gallons per cu. ft = 1,086,096 gallons.

If this quantity of water drains into the stream as direct run runoff, it will raise the height of the stream significantly. Frequently, improper planning for runoff from these kinds of developments have led to serious downstream flooding.

Although the case you have just studied is hypothetical, the problem of increased runoff from development and subsequent pollution does exist. There are many cases of once natural streams becoming severely eroded or flooding because of construction activity in their watersheds. By instituting a sound program of stormwater management, runoff can be retained temporarily and the degree of discharge can be effectively maintained in a range that existed prior to development. The following graph compares the quantity of runoff from a site before, during and after development. The dashed line indicates the way in which potentially damaging runoff can be controlled through a stormwater management program.



Source: Processes, Procedures, and Methods to Control Pollution Resulting from All Construction Activity, EPA Bulletin 430/9-73-007, p. 109.

As you study the graph, there are several important factors which you should observe. In the predevelopment state the peak runoff period occurred about 40 minutes after the start of the storm at a level of about 80 cubic feet per second. During development, runoff peaked at about 30 minutes after the start of the storm of a rate of about 270 cubic feet per second. After development runoff peaked at about 25 minutes after the start of the storm at about 540 cubic feet per second. With a stormwater management program the runoff peak was reached at about 45 minutes at 110 cubic feet per second and stayed at the level until approximately 90 minutes after the start of the storm.

Waterworks

As described in the fall issue, resource centers containing curriculum materials and references for marine and aquatic education are being established at three locations in the state. One already exists in our office at Ohio State. Addresses of the other two under development are:

Marine Resource Center
Center for Environmental Programs
Hayes Hall
Bowling Green State University
Bowling Green, Ohio 43403

Marine Resource Center
Science and Environmental Education Center
Teachers College #2
University of Cincinnati
Cincinnati, Ohio 45221

Some of the more exciting new additions to these centers are described below:

Hunt, John D. (Editor), Marine Organisms in Science Teaching. Sea Grant College Program, Texas A & M University, 1980.

A loose-leaf book containing 42 classroom tested activities for grades 4-12. It presents action-oriented experiences using hardy organisms that are easily cared for in standard classroom situations. (To order your own copy, send $4.00 to the Marine Information Service, Texas A & M, College Station, TX 77843.)

Odell-Fisher, Ellen and Ronald N. Giese, Sensing the Sea. Virginia Institute of Marine Science, 1979.

A 44-page curriculum guide in marine education for kindergarten and first grade. Facts are used as vehicles for developing interest in the marine environment and for teaching inquiring skills. Subjects include marine aquaria, art, children's books, science, motor skills and language skills. (To order your own, send $2.00 to the Marine Education Center, VIMS, Gloucester Point, VA 23062.)

Michigan Sea Grant, The Sea Lamprey in the Great Lakes. University of Michigan, 1981.

An interdisciplinary package of materials for grades 6-8, this three-week unit contains ten activities and two filmstrips/tapes, a board game (in class quantity) and ditto masters. This unit is the first of five in Michigan Sea Grant's Great Lakes Environment Curriculum. It is a detailed examination of an environmental problem and the management strategies developed in response to it. (Unit can be ordered for $37.50 from 2200 Bonisteel Blvd., Ann Arbor, MI 48109.)

Project COAST materials, College of Education, University of Delaware, Newark, DE 19711.

In addition to a complete set of interdisciplinary curriculum materials (K-12), which each resource center has, Project COAST has published a series of bibliographic references that are extremely valuable to marine and aquatic educators.

- --A List of Books on the Marine Environment for Children and Young People, annotated, 65 pages, $2.00.
- --Audio-Visual Aids and Art for Marine Environment Studies, Elementary and Secondary, annotated, 45 pages, $1.00.
- --A Catalog of Curriculum Materials for Marine Environment Studies, Elementary and Secondary, annotated, 45 pages, $1.00.
- --An Annotated Bibliography of Periodical Sources for Marine Environment Studies (Newsletters, Bulletins, Journals and Magazines), 19 pages, $1.00.

Copies of these references are found in each of the three Resource Centers.

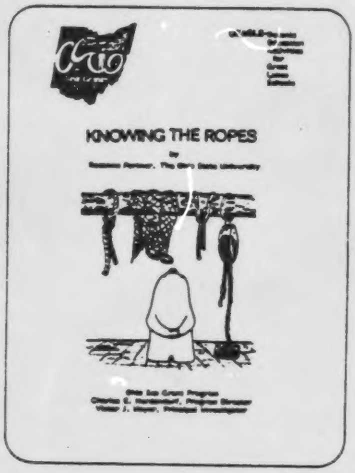
OEAGLS

Middle Sea was originally designed to be the vehicle for disseminating information about Oceanic Education Activities for Great Lakes Schools (OEAGLS), curriculum materials from the Ohio Sea Grant Education Program. In this, our second anniversary issue, we are proud to announce the successful completion of the OEAGLS project and the availability of the "last" four investigations. We suspect that the need for other topics (some of which we've already identified!) will draw us into further curriculum development, but for now such work must become incidental rather than intensive. The list of our 23 topics, with ordering instructions, appears on page 9.

SHIPPING: THE WORLD CONNECTION

A study of the Port of Toledo gives indications of the impact of the Great Lakes in world commerce. Students construct a model lock system to show how boats go from the ocean to Great Lakes ports.

SHIPPING: THE WORLD CONNECTION

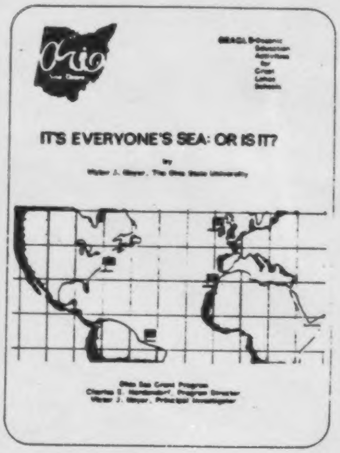

KNOWING THE ROPES

KNOWING THE ROPES

Students unmake a rope to see what gives it strength, then learn to tie several sailors' knots. Lab exercise shows how block-and-tackle helps increase the amount of weight a person can move. The marine origins of common sayings form the basis of a creative arts activity.

IT'S EVERYONE'S SEA: OR IS IT?

Map study of the characteristics of the ocean floor and continental margins leads to consideration of how international boundaries are determined at sea. A Law of the Sea simulation reveals interests that various types of countries have in the sea.


IT'S EVERYONE'S SEA: OR IS IT?

PCBs IN FISH: A PROBLEM?

PCBs IN FISH: A PROBLEM?

Students examine statistics on levels of PCBs in fish of Lake Erie and Lake Ontario and learn how these levels affect fish consumption. A simulation of state health policy determination follows, based on data presented.

OEAGLS ORDER FORM

MS-32

Please send copies of the Student and Teacher Guide for the materials checked below, at $1. per investigation:

____ The Effect of Lake Erie on Ohio's Temperature
____ The Effect of Lake Erie on Climate
____ Ancient Shores of Lake Erie
____ How to Protect a River
____ Lake Erie and Changing Lake Levels
____ Erosion Along Lake Erie
____ Coastal Processes and Erosion
____ Pollution in Lake Erie: An Introduction
____ Yellow Perch in Lake Erie
____ Evidence of Ancient Seas in Ohio
____ To Harvest A Walleye
____ Oil Spill!
____ Shipping On The Great Lakes
____ Geography of the Great Lakes
____ Ohio Canals
____ The Estuary: A Special Place
____ The Great Lakes Triangle
____ Getting to Know Your Local Fish
____ We Have Met the Enemy
____ PCBs in Fish: A Problem? *
____ Shipping: The World Connection *
____ Knowing the Ropes *
____ It's Everyone's Sea: Or Is It? *

____ Place my name on the mailing list for Middle Sea (no charge).

*New investigation

Total number of investigations = ________
Duplication costs x $1.00
Subtotal = ________
Postage and handling + $1.00
Total order = ________

Please enclose check or purchase order to Ohio Sea Grant Education Program.

Name ______________________________
Address ______________________________
____

MAIL TO: Ohio Sea Grant Education Office, 283 Arps Hall, 1945 N. High St., Columbus, OH 43210.

On the Horizon

March 7	Science Education Council of Ohio meets at COSI in Columbus. Oceanic activities (review of materials for use in science classes).
April 3-6	National Science Teachers Association Annual Convention, New York City. Sunday afternoon session on infusing marine topics into existing science curricula (panel).
April 8-9	Teachers Workshop in Toledo area (described on p. 2).
April 25	Ohio Academy of Science at College of Wooster. Sessions on invertebrates in the classroom and resources for science teachers in marine and aquatic education.
April 30 -	National Association for Environmental Education, annual convention, Land-Between-the-Lakes, Kentucky. Marine education displays and presentation planned.
Mid-July	Cleveland teacher seminar (see p. 5). Also within this period, Cleveland 4-H leaders and extension workshop.
August 5-8	National Marine Education Association annual convention, Galveston Island, Texas. Details in Spring issue.

Ohio Sea Grant

The Ohio State University
283 Arps Hall
1945 N. High Street
Columbus, OH 43210

Non-Profit Organization
U.S. Postage Paid
Columbus, Ohio
Permit #711

MIDDLE SEA

Just as musicians think outward from middle C to find direction for their music, Ohioans think outward from our middle sea, Lake Erie, in such a way as to trace its continuing impact on our lives.

MIDDLE SEA is published by the education office of Ohio Sea Grant, through a grant from the National Sea Grant Program of the National Oceanographic and Atmospheric Administration, the College of Education of The Ohio State University and the Ohio Department of Education. Its purpose is to build a greater awareness among Ohio school teachers and administrators of the important role the Great Lakes and marine education should play in school curricula. It therefore includes information about the marine and Great Lakes environments, classroom activities for marine education, and news of current events of interest to Ohio teachers.

Copies are available from:

Ohio Sea Grant Education Program
The Ohio State University
283 Arps Hall
1945 N. High Street
Columbus, OH 43210

Charles E. Herdendorf, Program Director
Victor J. Mayer, Education Coordinator
John Hug, Principal Investigator
Rosanne Fortner, Editor

ON THE AIR WAVES TOO

Heard anything about Lake Erie on the radio lately? Probably not, especially if you live in Central Ohio. But things will be changing soon, thanks to a Sea Grant research project directed by Rosanne Fortner.

Students in Fortner's environmental communications classes at Ohio State have been writing and tape recording information about Lake Erie that should interest central Ohio citizens. The one-minute recordings will be broadcast as public service announcements on ten Columbus-based radio stations. Every day in April a new announcement will be aired, and listeners may phone in to receive an illustrated pamphlet providing more information on the topics presented.

The research aspect of the project involves a listener survey before the broadcasts and again near the end of the series. Research Associate Dan Eikenberry, master's candidate in Natural Resources, is presently working on the pre-broadcast survey, and students in Fortner's graduate environmental communications course will follow up the series with a similar survey and analysis.

It is hoped that not only will listeners learn more about our middle sea, but also that Sea Grant can gain a measure of how well radio serves to communicate this information. Based on the response to the programs, a recommendation can be made about whether to consider a regular radio program for Sea Grant information in the future.

APPENDIX E

OEAGLS Catalog

Oceanic Education Activities for Great Lakes Schools

OEAGLS:

interdisciplinary investigations for grades 5-9

Ohio Sea Grant
and
The Ohio State University

OEAGLS

Development Staff

PRINCIPAL INVESTIGATORS: OSU faculty responsible for writing and revision of investigations

Victor J. Mayer
Rosanne W. Fortner

ASSISTANTS: teacher trainees who assist in activity development and dissemination

Stephanie Ihle
Dan Jax
Gabriele Reil
Joyce Timmons
Amy White Predieri
Christopher Williams

CLASSROOM TEACHERS: development of materials

Dorothy Briss
Lance Clarke
James Comienski
Carolyn Farnsworth
Don Hyatt
Beth Kennedy
Carol Basehore
Susan Leach
James Meinke
Ron Mischler
Ray Pauken
Frank Pigman
Keith Schlarb

CONTENT EXPERTS: evaluation of content of investigations

Mark D. Barnes
Charles E. Carter
Jane Forsythe
Norman A. Fox
Suzanne M. Hartley
Charles E. Herdendorf
Henry L. Hunker
David L. Johnson
David Klarer
Gary McKenzie
Michael T. Metcalf
Scott Peters
Jeffrey M. Reutter
William R. Riley
Russell L. Scholl
Frederic L. Snyder
John J. Spittler
Russell O. Utgard

The development of these materials was funded by the Sea Grant Program of the National Oceanic and Atmospheric Administration, the College of Education and the Center for Lake Erie Area Research of the Ohio State University.

Ohio Sea Grant

Charles E. Herdendorf, Director
Victor J. Mayer, Education Program Coordinator

Description of Investigations

HE EFFECT OF LAKE ERIE ON OHIO'S TEMPERATURE (EP-1)

Differences in heat absorption and release by soil and water show how lakes and oceans moderate land temperatures. Laboratory and map activities.

Science, geography.

HE EFFECT OF LAKE ERIE ON CLIMATE (EP-2)

Effect of temperature on movement of air; land and sea breezes and how they influence climate and economy near large bodies of water. Demonstration and graphing activities.

Science, geography.

NCIENT SHORES OF LAKE ERIE (EP-3)

Beach ridges along the lake are evidence of former lake levels related to glaciation. Characteristics of ridges make them valuable for human uses. Map study.

Science, geography, history.

OW TO PROTECT A RIVER (EP-4)

River characteristics are compared with standards for water quality and development. A decision is made about classifying the river as wild, scenic or recreational. Map study, data usage.

Science, social studies.

AKE ERIE AND CHANGING LAKE LEVELS (EP-5)

Causes and effects of lake level fluctuations lead to a study of problems involved in regulating lake levels. Laboratory and graph interpretation.

Science, social studies.

ROSION ALONG LAKE ERIE (EP-6)

Determination of recession rate along a shoreline using maps and aerial photos. Effect of coastal erosion on property. Map study, calculations.

Mathematics, science, social studies.

OASTAL PROCESSES AND EROSION (EP-7)

Processes involved in coastal erosion and the effect of erosion on different shore materials. Shore protection devices and how they work. Laboratory.

Science.

OLLUTION IN LAKE ERIE: AN INTRODUCTION (EP-8)

A 1970 essay is used to illustrate how to read skillfully and critically for facts about water quality in the lake. A current (1980) article updates and clarifies. Reading activity.

Language arts, science.

YELLOW PERCH IN LAKE ERIE (EP-9)

Introduction to fish life cycle and factors affecting population size, used as background for role-play of setting fisheries management policy. Extended to policies for 200-mile limit. Board game and simulation.

Science, social studies, mathematics.

EVIDENCE OF ANCIENT SEAS IN OHIO (EP-10)

Ohio rocks and minerals give evidence of the seas that formerly covered the state. Locations of economic deposits of minerals are studied. Laboratory and map study.

Science, geography.

TO HARVEST A WALLEYE (EP-11)

Basic concepts of food chains, webs and pyramids, with environmental factors and energy transfer. Desirability of using lower trophic levels for human food. Board game and extensions.

Science, mathematics.

OIL SPILL! (EP-12)

Sources of oil in water environments and methods for oil spill clean-up. Effect of oil on aquatic life. Laboratory and graphing activities.

Science, social studies.

SHIPPING ON THE GREAT LAKES (EP-13)

Commerce between lake ports illustrates regional products and needs. Cost and energy efficiency of cargo transport methods. Data analysis.

Geography, mathematics.

GEOGRAPHY OF THE GREAT LAKES (EP-14)

Location and importance of Great Lakes areas. Distance-rate-time problems and area, perimeter, volume determinations. Map study and laboratory.

Geography, mathematics, science.

OHIO CANALS (EP-15)

Effects of canal building on the population and economy of cities. Canal routes are plotted, and life on canal boats is revealed through a song. Map study, data interpretation.

Geography, history.

THE ESTUARY: A SPECIAL PLACE (EP-16)

Computer map shows land use around estuary. Simulated sampling techniques reveal life forms in and around water. Influence of people's activities considered. "Dry lab" data analysis.

Science, social studies, mathematics.

THE GREAT LAKES TRIANGLE (EP-17)

Explores logical explanations for "mysterious" loss of the Edmund Fitzgerald and other crafts in the Great Lakes. Considers ship construction, storm tracking and uncharted reefs. Map study, weather station models, contour map construction.

Geography, science, language arts, music.

KNOWING THE ROPES (EP-18)

How ropes are made, what makes them strong, how they are (and were) used on ships. Influence of the sea on language. Laboratory activities.

Science, history, language arts, art.

GETTING TO KNOW YOUR LOCAL FISH (EP-19)

Construction and use of a dichotomous key to families of fish in Lake Erie. Creative art and writing about the origin of fish names.

Science, art, language arts.

SHIPPING: THE WORLD CONNECTION (EP-20)

Countries represented by ships using the Port of Toledo indicate the Great Lakes' importance in world trade. How locks work to move vessels through the lakes. Laboratory, map study.

Geography.

WE HAVE MET THE ENEMY (EP-21)

The War of 1812 in the Northwest, its causes, the role of Lake Erie, and the factors important in winning the war. Board simulation, analysis of original documents.

History (High School Level)

IT'S EVERYONE'S SEA: OR IS IT? (EP-22)

Characteristics of the ocean floor and how international boundaries are determined. Simulation of the Law of the Sea conference. Map study, role-play.

Social studies, science, history.

PCBs IN FISH: A PROBLEM? (EP-23)

PCBs in Lakes Erie and Ontario and the degree to which they affect consumption of fish. Simulation of state health policies. Graph construction and laboratory-demonstration.

Science, social studies.

ORDER FORM

Please send copies of the student and teacher guide for the materials checked below:

INVESTIGATION

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Mail to: Ohio Sea Grant Education Office
283 Arps Hall
1945 N. High Street
Columbus, Ohio 43210

APPENDIX F

Marine and Aquatic Education

ENVIRONMENTAL EDUCATION

Occasional Paper #6

Marine and Aquatic Education

Office of Environmental Education
Ohio Department of Education
Columbus, Ohio 43215

August 1981

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Office of Environmental Education

AUTHOR

Diane Cantrell

The author began her career as a French and English teacher. She provided her students many interesting and worthwhile activities using the rich learning resources of the environment. These successful environmental education experiences led to extensive graduate studies in environmental education, teacher education, and curriculum development. Diane has developed a special interest in the global implications of environmental issues and how classroom teachers can improve their skills in this critical area of elementary and secondary education.

TABLE OF CONTENTS

Page

Foreword ii
Water in the World 1
    The Limits to Water 1
    Pushing the Limits 2
    Protecting the Limits 3
An Overview of Marine and Aquatic Education 4
    Dimensions of Marine and Aquatic Education 4
    Definitions and Objectives 5
Formal Education 6
    Environmental Education 7
    General Education 8
    Incorporating Marine and Aquatic Education into the Existing Curriculum 9
People, Places and Materials 12
    Ohio Sea Grant 12
    Ohio Department of Education, Office of Environmental Education 14

    State Agencies 14
    Universities and Colleges 15
    Other Organizations and Places 15
Conclusion 15
References 17

Appendices 18
    Appendix A 18
    Appendix B 20
    Appendix C 22

FOREWORD

Marine and aquatic education has been a part of the curriculum in Ohio elementary and secondary schools for many years. Teachers and students have investigated ponds and streams, read about the early world explorers, studied the complexities of world trade and have been tuned in to such contemporary maritime happenings as the sinking of the Edmond Fitzgerald or the wreck of the oil tanker Torrey Canyon. This occasional paper is offered to Ohio educators to stimulate creative activities and thereby provide students an even deeper understanding and appreciation of the world of water.

The Ohio Department of Education is pleased to be cooperating with Ohio Sea Grant to bring to elementary and secondary students an increased awareness and understanding of marine and aquatic education.

The Office of Environmental Education invites and encourages comments on this paper.

WATER IN THE WORLD

Few of us realize to what extent we depend on the world of water in our daily lives. Every time we bite into a cream-filled cupcake, eat an ice cream cone, paint a wall or brush our teeth we are using a seaweed derivative which helps to maintain a creamy texture. When we feed our pet or eat a drumstick, we are benefiting from the use of fish meal in animal foods.

Oil is only one item for our cars which is shipped by water from overseas. The raw materials and parts for a single car come from over 70 different nations (1: 25). Consequently, the production and cost of land transportation are closely tied to the water transportation system.

Because of Lake Erie's effect on weather, the residents of Painesville, Ohio, have to shovel more inches of snow than the people living in Toledo. Even our language reflects the impact of water. Today's meanings for "making ends meet," "mind your p's and q's," or "skyscraper" bear little resemblance to their original maritime contexts.

The Limits to Water

A lack of awareness of our daily ties to water would pose little problem if we had unlimited quantities of water for domestic, industrial and agricultural use. But we do not. We are deceived by the vastness of the water world. Long before photographs from space showed the earth as a bluish marble, children were learning in school that three-fourths of our planet is covered by water. Few learn, however, that oceans, ice caps, and glaciers constitute 99.35 percent of that water (8: 11).

While the frozen water and the oceans are important in our lives, it is the remaining 0.65 percent which we use more directly for day-to-day activities.

Here lies another misconception. The limited amount of water would pose little problem if rain and rivers brought new water. But the earth is a closed system. There is essentially the same amount of water today as there was three billion years ago; we continue to use it over and over again. As we turn on the faucet in the morning to make a cup of coffee or mix orange juice, we assume that the water is safe to drink. Although we may know that it came through the local water treatment plant or filtered through the ground to our well, we seldom think beyond our local resources; yet, we should. As Anderson explains,

> The water you drank this morning fell as rain on Lake Michigan two weeks ago. Three months prior to that the water was evaporating from a lake in central Asia. Two months prior to that it was part of the water a Korean mother was using to bathe her infant daughter. Now you have used it to satisfy your thirst. Two hours from now it will leave you as urine and two months later it may be part of a summer rain falling on the streets of Paris (1:29).

Where was it before Korea and where will it go after Paris?

Pushing the Limits

We live in a global society which is pushing the limits of water through growth and demand. Increases in population, shifts in population from inland to coastal areas and rising consumption have led to increasing demands for water and water resources. Since water is limited in quantity and recycled, efforts to keep up with human needs have often resulted in detrimental impact on the water environment.

For example, increasing demands for food may lead to water shortages due to irrigation. Lowered water quality because of soil, fertilizer and pesticide run-off and the depletion of fish populations due to over-harvesting also produce negative impacts. This in turn will affect the physical, sociological and economic well-being of people in the future. Other demands for water and water resources (e.g. energy, recreation, natural resources, transportation, defense) lead to similar repercussions.

When the negative effects appear obvious or dramatic, some people may only express concern while others may take action to correct the problem. This is often the case, for instance, when people see oil covered birds dying as a result of an oil spill or blowout. However, the gradual deterioration of the water environment goes unnoticed by most. For example, more oil enters the oceans from improperly disposed waste oil from automobile crank cases and machines than from oil spills or blowouts. (7:286). The run-off of petroleum chemicals from automobiles and other land sources is approximately 24 times as great as petroleum pollution from offshore drilling (4:13). In addition, this less visible pollution often impacts more on the water environment since it usually affects the most productive area of the ocean, the coastal zone.

Protecting the Limits

Our existence depends upon careful, planned use of oceanic and fresh water resources. However, we are hindered in our efforts to protect and responsibly use the water environment by a lack of awareness about our daily dependence on water, limited knowledge about this important life support system and lack of understanding about how society affects the water environment. The quality and quantity of future water resources depends upon correcting these deficiencies. Marine and aquatic education represents one effort to address this very difficult and complex task.

AN OVERVIEW OF MARINE AND AQUATIC EDUCATION

Marine and aquatic education evolved from the science education movement which was spurred by the launching of Sputnik I and the environmental movement which was marked by Earth Day in 1970. The scope and goals of marine and aquatic education encompass much more than its roots indicate.

Dimensions of Marine and Aquatic Education

Much of our daily life is dependent upon water. Marine and aquatic education must reflect this fact. The following list indicates some of the various dimensions of marine and aquatic education. It is not intended as a comprehensive outline but rather as a stimulus in thinking about the broad scope of marine and aquatic education.

Culture: art, music, literature, heritage
Energy Sources: oil, coal, wind, waves, tides, hydro, solar, thermal, nuclear
Human Impact: pollution, development, over-use
Marine & Fresh Water Ecology: lakes, ponds, rivers, swamps, estuaries, seas, oceans
Maritime and Naval History: explorers, wars, shipbuilding, shipwrecks
Physical Forces: wind, waves, currents, tides, erosion, coastal processes, crustal evolution
Properties of water: physical, chemical
Recreation: fishing, boating, swimming
Transportation and Commerce: shipping, world trade, canals, ports, imports/exports
Uses of Water: domestic, industrial, agricultural
Weather and Climate: temperature, precipitation, wind directions

Efforts to educate people about the world of water should include these and other elements and how they relate to ecological, political, economic, sociological and technological concerns.

Definition and Objectives

With the foregoing material as a background, the question becomes, What is marine and aquatic education? Goodwin and Schaadt (4:6) wrote one of the most accepted definitions:

> Marine and aquatic education is that part of the total educational process which enables people to develop a sensitivity to and a general understanding of the role of the seas and fresh water in human affairs and the impact of society on the marine and aquatic environments.

The primary objectives of marine and aquatic education are:

- to develop a public which is aware of and knowledgeable about the proper use, protection and conservation of the oceans, coastal zones and fresh water resources and,
- to motivate people to take part in decisions affecting the sea and fresh water.

The major intent, therefore, is not to produce a nation of marine biologists, oceanographers or hydrologists, but to develop a citizenry which is "marine literate."

The above explanation raises three important points. First, by using the term "marine and aquatic education," the definition addresses the total water system. The popular term "marine education" fails to explicitly include fresh water along with salty (marine) water. In reality most marine educators include both; however, the major focus usually remains on the marine environment.

Second, the emphasis on the "total educational process" indicates that this is not restricted to formal education. Aquariums, zoos, nature centers and other environmental education centers offer many nonformal opportunities for the general public as well as students to participate in marine and aquatic education experiences. Organizations and governmental agencies provide programs, materials and assistance. In addition, the mass media help to increase awareness and knowledge through news coverage, television serials, feature articles and productions, public service announcements, and specialized publications.

Finally, the use of the word "education" emphasizes that this is not a course, subject area or discipline. Within formal education, marine and aquatic education must shed its image as science or marine science and become a theme which permeates the total curriculum. Students who read *Moby Dick* or *Pagoo*, write a report about the War of 1812, create their own fish recipes, estimate the average number of organisms in an estuary, sing sea chanteys, draw their favorite marine animal or investigate the effect of Lake Erie on climate are all involved in marine and aquatic education.

FORMAL EDUCATION

Although many individuals and organizations support marine and aquatic education through nonformal approaches, most of the emphasis and efforts focus on formal education, beginning in kindergarten and continuing through post secondary work. Marine and aquatic education does not take the form of a course but rather that of a theme which draws upon appropriate methods and materials to complement and enhance existing educational goals and curricula. The following discussion first demonstrates how marine and aquatic education helps to meet the goals of environmental education and general education and then describes ways in which it can be incorporated into the existing curriculum.

Environmental Education

The basic aims of environmental education are to help individuals understand the biological, physical, social, economic and political dimensions of the natural and built environments and acquire the knowledge, skills and values to make responsible decisions related to the future quality of the environment. As one component of environmental education, marine and aquatic education helps to meet these goals in two ways.

First, water-related issues of concern to marine and aquatic education cannot be separated from concerns of other major components of environmental education. For example, the alternative energy sources studied in energy education all deal with water either directly (e.g. tides, waves, ocean thermal) or indirectly (e.g. nuclear, wind, solar). When world hunger is discussed in population studies, the misconception of the oceans as the future panacea for food and water shortages must be corrected. Pollution-related activities must indicate the limitations of ocean dumping and the dangers of improperly designed landfills.

Second, marine and aquatic education focuses on one of the major life support systems— water— and its interrelationship with the other systems— air, soil and life. Environmental education addresses all four equally.

General Education

In a similar way, both environmental education and marine and aquatic education help to achieve the goals of general education. While people do not always agree on what constitutes these goals, the Association for Supervision and Curriculum Development published the following list (2:9-12) which represents one view of current thinking in this area. It may be used to demonstrate how marine and aquatic education contributes towards meeting many of the educational goals of general education.

Goals of General Education

1. Basic skills
2. Self-conceptualization
3. Understanding others
4. Using accumulated knowledge to interpret the world
5. Continuous learning
6. Mental and physical well-being
7. Participation in the economic world of production and consumption
8. Responsible societal membership
9. Creativity
10. Coping with change

These goals, or similar ones suggested by other educators, are inherent in the primary objectives of marine and aquatic education identified in the preceeding section. In order for individuals to become aware of and knowledgeable about the water environment and its related issues, they must learn and practice basic skills, use accumulated knowledge to interpret the world, and cope with changes in the water environment, especially those that result from human impact. In order for individuals to take part in decisions affecting the sea and fresh water, they must understand how each person's decisions affect everyone else, exhibit responsible societal membership, and understand how their participation in the economic world of production and consumption affects the present and future water environment. Both of these major marine and aquatic education objectives require lifelong learning.

In this way, the goals of marine and aquatic education correspond closely to those of general education. Consequently, marine and aquatic education efforts may readily complement existing curricula designed to meet the goals of general education.

Incorporating Marine and Aquatic Education into the Existing Curriculum

Because of the interrelatedness of marine and aquatic education with general education and environmental education, it is reasonable to ask if we need another kind of education, especially when the field is already deluged with so many others (e.g. consumer education, global education, citizenship education, career education). The answer would be no if any educational efforts were adequately meeting the need for marine and aquatic education but they are not. Presently, schools appear to emphasize the importance of land over water as evidenced by a notable lack of water related examples, activities, units and courses in the existing curriculum. Water seems to be taken so much for granted that we fail to perceive the importance of it in the curriculum.

Marine and aquatic education uses a variety of approaches for incorporating water-related information, ideas and concerns into the curriculum. These may be broadly identified as the example approach, activity or unit approach, multidisciplinary theme approach, and specific courses. Since teaching styles, curriculums, and philosophies differ, educators may find one method more appropriate than another. In the end, a combination of these may lead to the best results.

With the *example approach*, teachers use water-related examples in place of or in addition to some of the land-oriented ones to teach the same skills or concepts. For instance, instead of adding and subtracting bushels of apples math students may be asked to add and subtract baskets of fish. Or they could solve story problems about fuel efficiency or distance-time rates of water transportation. For English, grammar exercises could contain sentences about water. Reading selections could include poems, stories, books and other pieces with water themes or settings. These kinds of substitutions and additions can easily be made in many subjects to increase awareness about marine and aquatic ideas without detracting from the teaching objectives of the discipline.

With the *activity or unit approach*, the teacher uses one or more marine and aquatic education activities or lessons to enhance and expand upon an existing water-related idea or topic. As students study transportation systems in Ohio and their impact on the state's development, they might construct a model of a lock system or use a water drainage map to decide where they would have located Ohio's canals. In a world history class, they could complete a unit on the role of the oceans in the spread of civilization. The activity or unit approach increases awareness, knowledge and understanding by deliberately teaching about water as it relates to the subject area.

With the multidisciplinary approach, teachers and students use skills and content information from several disciplines to investigate a theme or topic. This method lends itself well to both individual and team teaching. Students studying an estuary, for example, would draw upon science, math, social studies and English as they use a water testing kit, calculate averages or percentages, read a topographical or aerial map, interview local people (hunters, fishers, industrialists), use dichotomous keys and field guides, read local newspapers for evidence of land use conflicts, and observe and record signs of animals. An individual teacher can lead this kind of study or a team of teachers might coordinate a study of the oceans. For example, students in an English class could read Pearl Buck's "The Big Wave" as they study the physical forces of water in a science class, debate coastal zone management issues in a social studies class, calculate the rate of erosion along the coastline in math class and draw seascapes in art class. By drawing upon several disciplines, students not only use a variety of skills and information but they also gain a more comprehensive understanding of the world of water.

Finally, some schools and teachers prefer specific courses on a marine related topic (e.g. oceanography, literature of the sea) or a one-time marine education week. While these contribute to the efforts of marine and aquatic education, they fail to include it as an integral part of the total educational process as is possible with the example, activity, and multidisciplinary theme approach.

Regardless of the approaches used to incorporate marine and aquatic education into the existing curriculum, the success of any effort depends heavily upon teachers. Most educators have neither the time nor the resources to develop their own programs in marine and aquatic education. Fortunately, Ohio has many resources so that teachers do not have to "reinvent the keel."

PEOPLE, PLACES AND MATERIALS

Ohio has many organizations, agencies and institutions which provide a variety of services to educators including resource and curriculum materials, planning assistance, teacher education programs and field trips. Some of these relate to water in general while others emphasize places, topics or issues of special interest to Ohioans. For addresses and other sources of information, assistance and resource materials not listed below, see the appendices.

Ohio Sea Grant

Ohio Sea Grant is part of the National Sea Grant Program, which is a federal program committed to the better understanding, use, management, and protection of the resources of the seas and the Great Lakes. Similar to other state sea grant programs, Ohio Sea Grant has three components: research which investigates resource and management problems of Lake Erie and other water bodies; advisory services which convey these research findings to the public; and education which provides resource information and assistance to educators.

The Ohio Sea Grant Education Office directed the development and production of Oceanic Education Activities for Great Lakes Schools (OEAGLS--pronounced "eagles"). These 23 classroom activities for grades 5-9 cover a variety of topics including world shipping, oil spills, erosion, and the Great Lakes triangle. While many activities are science oriented, other subject areas included are geography, social studies, math, language arts, history, art and music. These allow students to better explore the economic, political, social, scientific and technological dimensions of the role of the Great Lakes and oceans in Ohio. Activity units usually take two to three class periods to complete. Materials include a teacher's guide and a student workbook which may be duplicated. In addition to the OEAGLS activities, the office distributes a quarterly newsletter entitled Middle Sea, conducts teacher workshops and courses, sponsors resource centers at three locations (Ohio State University, Bowling Green State University, University of Cincinnati) and provides consultation services.

Similar services are available from other Great Lakes sea grant programs. In particular, the Michigan Sea Grant Curriculum group has developed materials titled "Great Lakes Curriculum for Middle Schools." These are comprised of five individual units: The Sea Lamprey in the Great Lakes, Great Lakes Fishing in Transition, Water Quality, Great Lakes Urban Communities and Great Lakes Shipping. Complete units may take 10-30 class periods but most of the individual activities take one to three class periods. Materials include filmstrips and tapes, slides, simulation games, board games, wall maps and student materials for duplication.

Ohio Department of Education, Office of Environmental Education

For over 41 years, an environmental education consultant has provided assistance to Ohio teachers in elementary, secondary and teacher education. Curriculum and resource materials, consultation services, and pre- and in-service teacher programs focus on one or more of the interdisciplinary themes included within the broad scope of environmental education (e.g. energy, population, food, land use planning, ecology, conservation).

Since marine and aquatic education is also a component of environmental education, the Office of Environmental Education consultant has been federally designated as the marine education coordinator for the State of Ohio. In addition to the previously mentioned services, this person also co-directs several of the Ohio Sea Grant projects.

State Agencies

Two state agencies directly influence the use and management of water and water resources in Ohio. The Ohio Department of Natural Resources provides information and assistance about a variety of water-related topics including coastal zone management, fishing, watercraft safety, ground water, pond construction, glaciers and endangered aquatic species. The Ohio Environmental Protection Agency distributes brochures on public water supply and waste water. It also responds to inquiries about water regulations and their enforcement. Similar information is also available from the U.S. Environmental Protection Agency, Center for Environmental Research Information located in Cincinnati.

Universities and Colleges

Local institutions of higher education have two kinds of offerings useful to teachers. The first are content courses such as fresh water ecology, oceanography and marine biology. A directory of marine and aquatic content courses offered by Ohio colleges is available from the Ohio Sea Grant Education Office. The second are graduate and undergraduate method courses or workshops in environmental education and marine and aquatic education. In addition, university personnel and facilities may serve as a resource for teachers.

Other Organizations and Places

Numerous other resource people and places exist throughout the state. Some of these focus on features which are special for Ohio. For example, The Toledo Port Authority, the Great Lakes Historical Society and AmShip (American Shipbuilding Company) could be used to teach about Lake Erie, the Great Lakes and their connection to the Atlantic Ocean. The lock system on the Ohio River and the Ohio River Museum could also help teach about water transportation and ocean connections. Roscoe Village focuses on canals. Local zoos, aquariums, museums, parks, historical sites and environmental education centers may address local as well as general water-related topics. For more specific information, see Appendix C.

CONCLUSION

Ohio may not be located on the ocean but we are directly connected to the Atlantic and the rest of the world by the Great Lakes and the

Ohio River. In addition, we are indirectly connected in countless ways on a day-to-day basis. Our lives are dependent upon water and the future quality of our lives is dependent upon how well we understand, protect and conserve our water resources. Ohio has the people, places and resources for meeting the need for marine and aquatic education.

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APPENDIX A*

Sources of Information and Assistance

Educational Resource Information Center, Clearinghouse for Science, Mathematics and Environmental Education (ERIC/SMEAC). The Ohio State University, 1200 Chamber Road, Room 310, Columbus, Ohio, 43212. A microfiche computerized collection of research and resource documents of use to educators at all levels. ERIC is located in most university libraries. Over 1500 documents have marine education significance.

Marine Education Materials System (MEMS). Microfiche computerized collection of marine education material which is constantly being updated. Obtain "The Guide to Marine Education Materials" from Sea Grant Publications, VIMS, Gloucester Point, VA, 23602.

National Oceanic and Atmospheric Administration, Department of Commerce, Washington, D.C., 20230. For meteorological and oceanographic information, contact the Office of Public Affairs.

National Marine Education Association, Virginia Institute of Marine Science Education Center, Gloucester Point, VA, 23062. This office can direct you to regional organizations and individuals who can provide assistance. NMEA publishes Current: Journal of Marine Education which carries a wide range of marine education articles.

Office of Sea Grant, NOAA. 6010 Executive Boulevard, Rockville, MD., 20852. The Maryland office can give you information concerning the nearest Sea Grant program and relevant Sea Grant supported educational projects. The Sea Grant program is located in thirty states; supported by federal/state funding it promotes the wide use of marine resources through research, education and advisory services.

Ohio Department of Education. The state marine education coordinator, appointed by the chief state school officer, is available to conduct workshops, provide information and consult with educators. Office of Environmental Education, Ohio Department of Education, 65 S. Front Street, Room 811, Columbus, Ohio, 43215.

Ohio Department of Natural Resources, Fountain Square, Columbus, Ohio, 43224. For general information or educational assistance, contact the Office of Public Information and Education. For specific information, contact one of the divisions. (Geological Survey, Natural Areas and Preserves, Parks and Recreation, Soil and Water Districts, Water, Watercraft, Wildlife).

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* Some of the information in this appendix was adapted from 5:5.

Ohio Environmental Protection Agency, 361 E. Broad Street, Columbus, Ohio, 43215. Contact the Public Interest Center, the Office of Public Water Supply or the Office of Wastewater Pollution Control.

Ohio Sea Grant. Three branches provide research and education information and assistance to Ohioans.

1) Ohio Sea Grant Program, Center for Lake Erie Area Research, 484 West 12th Avenue, Columbus, Ohio, 43210;
2) Ohio Sea Grant Extension Program located at the above address with Sea Grant area extension agents at three locations:
    a) Lorain County Extension Office, 1575 Lowell Street, Elyria, Ohio, 44035,
    b) Lake County Extension Office, 99 East Erie Street, Painesville, Ohio, 44077, and
    c) Fremont Area Extension Center, 1401 Walter Avenue, Fremont, Ohio, 43420; and
3) Ohio Sea Grant Education Office, 1945 N. High Street, Columbus, Ohio, 43210

U.S. Coast Guard. For information on boating and pollution control, contact Boating Safety, Ninth Coast Guard District Headquarters, Federal Office Building, Room 2061, 1240 E. 9th Street, Cleveland, Ohio, 44199.

U.S. Environmental Protection Agency, Center for Environmental Research and Information, 26 W. St. Clair, Cincinnati, Ohio 45268. Address inquiries to "Public information."

APPENDIX B*

Resource Materials

Childrens' Literature-Passage to the Sea. N. Bagnall, 1980. Sea Grant/ Texas A&M, College Station, Texas, 77843. Gives ideas for hands-on activities for learning stations which focus on three children's books—one for primary, one for upper elementary, and one for middle school.

Coastal Problems and Resource Management: A Secondary Social Studies Course. Curriculum Research and Development Group, University of Hawaii, Honolulu. 1979. Materials include a book of readings, student worksheets and a simulation game called Ostrich Bay.

Great Lakes Curriculum for Middle Schools. Michigan Sea Grant Curriculum Team, c/o Dr. Paul Nowak, School of Natural Resources, Dana Building, University of Michigan, Ann Arbor, Michigan, 48109. Contains multidisciplinary units on the sea lamprey, fishing, water quality, urban communities and shipping.

High School Marine Science Study Project (HMSS). Curriculum Research and Development Group, University of Hawaii, Honlulu, 1979. Contains 10 chapters of activities which focus on three themes: fluid earth, living ocean and technology.

Investigating the Marine Environment: A Sourcebook. H. M. Weiss and M. W. Dorseg, 1979. Three volumes. Project Oceanology, Avery Point, Groton, Connecticut, 06340.

Investigating the Marine Environment and Its Resources. V. Lien, 1979. Texas A&M Sea Grant University Program, College Station, Texas, 77843. Two volumes of interdisciplinary activities and information on the Gulf Coast.

Marine Organisms in Science Teaching. J. D. Hunt, ed. Texas A&M College Program, College Station, Texas, 77843. Contains supplemental, hands-on investigations for a laboratory-oriented science program for grades four through twelve.

Marine Science Education Project. University of Maryland Sea Grant Program, H. J. Patterson Hall, Room 1222, College Park, Maryland, 20742. Three titles are available: Food Webs in an Estuary, The American Oyster, and Tides and Marshes.

North Carolina Marine Education Project. UNC Sea Grant College Program, 105 1911 Building, NCSU, Raleigh, North Carolina, 27650. Five volumes covering specific topics like coastal geology and history.

* Some of information in this appendix was adapted from 5:5.

Northern New England Marine Education Project. 1979. Sea Grant/College of Education, University of Maine, Orono, Maine, 04469. Over fifteen volumes covering interdisciplinary topics like whales, art, aquaculture, ships and aquariums.

Ocean Related Curriculum Activities (*ORCA*). Sea Grant/Pacific Science Center/Sea Grant, 200 2nd Avenue North, Seattle, Washington, 98109. Over eight volumes covering specific topics from navigation to indians to beaches.

Oceanic Education Activities for Great Lakes Schools. Ohio Sea Grant Education Office, The Ohio State University, 283 Arps Hall, 1945 N. High Street, Columbus, Ohio, 43210. Collection of twenty-three multidisciplinary activities for grades five through nine on topics like climate, erosion, pollution, shipping, and fish.

Project COAST. Sea Grant/University of Delaware, University of Delaware, 310 Willard Hall, Education Building, Newark, Delaware, 19711. Series of over 125 topic-oriented packages covering various topics such as dune dances, marine stories and oysters. 1974.

"Sensing the Sea." (Grades Two-Three) E. Odell-Fisher and R. N. Giese, 1978. Virginia Institute of Marine Science, Gloucester Point, Virginia, 23062. Contains hands-on elementary activities which focus on the characteristics of the coastal area and the life which exists there.

Smithsonian Estuarine Activities (*SEA*). S. P. Gucinski, ed., 1979. Smithsonian Institution, P.O. Box 28, Edgewater, Maryland, 21037. A series of activities investigating marshes and estuaries.

The Source Book of Marine Sciences. S. Dobkin, ed., 1980. Florida Oceanographic Society, 1212 Riverside Drive, Stuart, Florida, 33494. Laboratory experiments of the oceans.

Wet, Wild and Deep, the Physical Ocean. Institute for Marine and Coastal Studies/Sea Grant, USC, University Park, Los Angeles, California, 90007.

APPENDIX C*

Ideas for Field Trips and Other Educational Opportunities

Boat Rides

Canal Fulton: The St. Helena II, a full-size replica of a mule-drawn Ohio freight barge (in town on SR 93).

Cincinnati: Delta Queen and Mississippi, steamboat tours of the Ohio and Mississippi Rivers.

Cleveland: Goodtime II, sightseeing cruises on the Cuyahoga River and and harbor (departs from E. 9th Street Pier).

Coshocton: Monticello II, canal boat ride near Roscoe Village (on SR 16 and 83 at jct. U.S. 16).

Piqua: A mule-drawn canal boat ride at the Piqua Historical Area (off SR 66, 2½ miles north).

Zanesville: The Lorena Sternwheeler, a replica of a turn-of-the century sternwheeler on the Muskingum River (Putnam Landing dock on Muskingum Avenue, ¼ mile from south end of 6th Street Bridge).

Historical Sites

Coshocton: Roscoe Village, a restored 19th-century Ohio-Erie canal town (on SR 16 and 83 at jct. U.S. 16).

Garrettsville: Hopkins Old Water Mill (1804), an operating mill with authentically reproduced water wheel (in town on SR 82).

Put-in-Bay on South Bass Island in Lake Erie: Perry's Victory and International Peace Memorial, commemorates the Battle of Lake Erie during the War of 1812 (reached by automobile ferries from Catawba or Port Clinton).

Industry

Lorain: American Shipbuilding Company (AmShip Division) Lorain Yard, tours of shipbuilding and repair facilities (400 Colorado Avenue, 44052).

Painsville: Morton Salt Company Fairport Mine, tour of facilities (near mouth of Grand River).

Toledo: AmShip, see Lorain, (2245 Front Street, 43605).

Locks

Muskingum River: For information about locations, facilities and tours, contact Muskingum River Parkway, Parkway Office, Box 2806, Zanesville, Ohio, 43761.

Ohio River: For information about locations, facilities and tours, contact U.S. Army Corps of Engineers, Huntington District, Box 2127, Huntington, West Virginia, 25721.

* Some of the information in this appendix was adapted from the 1981 American Automobile Association *Tour Book* for Ohio.

Museums

Cleveland: Cleveland Museum of Natural History (Wade Oval in University Circle).
Cincinnati: Cincinnati Museum of Natural History (1720 Gilbert Avenue near the entrance to Eden Park).
Columbus: Center for Science and Industry (280 E. Broad Street).
Columbus: Ohio Historical Society (jct. I-71 and 17th Avenue).
Dayton: Dayton Musuem of Natural History (2629 Ridge Avenue).
Fairport Harbor: Fairport Marine Museum (129 2nd Street).
Marietta: Ohio River Museum and the W.P. Snyder, Jr., one of the first all-metal, steam powered towboats on the Ohio River (Washington and Front Streets).
Vermilion: Great Lakes Historical Society Museum (480 N. Main Street).

Natural Areas, Preserves and Parks

Many organizations own properties which contain lakes, streams, marshes, bogs, estuaries or other bodies of water. Some of these organizations provide opportunities for individualized exploration while others make available naturalists or other personnel for guided tours. For specific information contact:

Ohio Department of Natural Resources, the Divisions of Natural Areas and Preserves, Parks and Recreation or Wildlife, Fountain Square, Columbus, 43224.
The Ohio Historical Society, Interstate 71 and 17th Avenue, Columbus, 43211.
The Nature Conservancy, Ohio Chapter, 1504 West First Avenue, Columbus, 43212.
Local Parks (city, county, metro), nature centers, camps, environmental education centers, school land labs.

Ports

Ohio has ports at five locations: Ashtabula, Cleveland, Conneaut, Lorain and Toledo. Guided tours may be arranged at Cleveland and Toledo Port Authorities.

Zoos

Aurora: Sea World, family entertainment, school programs and teacher workshops (3 miles northwest on SR 43).
Cleveland: Cleveland Aquarium, marine and fresh-water plants and animals (off I-90 at E 72nd Street exit in Gordon Park).
Cleveland: Cleveland Metroparks Zoo (in Brookside Park with entrance off W. 25th Street).

Cincinnati: Cincinnati Zoological Gardens (exit 6 off I-75, following signs to Vine Street and Erkenbrecher Avenue).
Columbus: Columbus Zoo, with aquarium (at O'Shaughnessy Dam on SR 257 at 9990 Riverside Drive).
Sandusky: Cedar Point's Oceana, performing dolphins and aquazoo (reached by toll causeway off U.S. 6, 10 miles north of Ohio Turnpike exit 7).
Toledo: Toledo Zoological Park, with a large fresh-water aquarium (3 miles southwest on U.S. 24 at 2700 Broadway).
Youngstown: For Nature Center, semiaquatic terrarium and aquariums with indigenous fish, plants and crayfish.

Miscellaneous

Castalia: Blue Hole, artesian spring of azure water of unknown depth, trout exhibit, and fish (½ mile north on SR 269).
Kelleys Island in Lake Erie: resort, grapes, quarries, glacial grooves (by ferry from Sandusky or Marblehead).
Marblehead: resort, fishing center, light house, quarries.

OCCASIONAL PAPERS

This is the sixth in a series of papers designed to provide interested people with some current information about environmental education. The occasional paper format was chosen because it provides for rapid production and, therefore, timeliness. The varied topics of these papers will allow them to be distributed to different and specific audiences.

Other topics now being considered for publication are:

An Explanation of Appropriate Technology

School Land Laboratories: Their Use and Development

Resident Outdoor Education: Some Program Guidelines

Responsibilities of a School District Coordinator of Environmental Education

Suggestions for other topics will be welcome.

Authors for these papers will be Ohioans both in and out of the Ohio Department of Education and, therefore, the views expressed are those of the authors, and not necessarily those of the Ohio Department of Education.

APPENDIX G

Comprehensive Evaluation Form for Awareness Workshops

Marine and Aquatic Education Teacher Workshop
Evaluation Form

The leaders hope this has been a beneficial experience for you. We tried to plan it so it would be the most useful in your present teaching responsibility. Please give us information that will improve the workshops we are planning in the next two years for other teachers throughout Ohio. They will benefit from your candid responses. Thank you.

Your grade and/or subject ______________________________

1. Please react to the general ATMOSPHERE we created. warm, friendly, accepting, pleasant, helpful, relaxed, enjoyable, or the opposites. What should we do to change or improve it?

2. Please tell us if we have helped you increase your knowledge about and understanding of Marine and Aquatic Education and the need for it in the curriculum of Ohio's elementary and secondary schools. What else would be helpful?

3. Please tell us if we have given you sufficient help in finding the RESOURCES you will need in preparing future marine and aquatic education activities you will want to do with your students. What else would be helpful?

4. What else did we do well? Not so well? Your comments will help us to do a better job for teachers from all over Ohio.

(over)

5. Do you feel that Lake Erie is an appropriate topic for inclusion in your curricula? Has your opinion on this changed as a result of this workshop? Explain.

APPENDIX H

Sample Syllabus for Implementation Workshop

ED 727P01
3 credits
Workshop in Marine and Aquatic Education
COURSE SYLLABUS
Spring 1983

Instructors

Dr. Victor J. Mayer, Professor of Science Education and Geology, OSU
Dr. Rosanne W. Fortner, Assistant Professor of Natural Resources, OSU

Office: 283 Arps Hall, 1945 N. High St., Columbus, Ohio 43210
(614) 422-4121

Objectives

Participants will:

1. learn information about Ohio's waterways and the world's oceans;
2. participate in activities useful for teaching water-related concepts in the arts, science and social studies;
3. study the current status of biological and physical resources of the seas and the Great Lakes;
4. design classroom activities that lead to an understanding of the importance of water in the history, culture and economy of Ohio and the nation;
5. participate in field experiences along the Lake Erie shore.

Topic Outline

A. The World's Oceans

  1. Information

    a. Origin of the ocean basins and continents
    b. The water of the oceans
    c. The influence of the oceans on weather and climate
    d. The life of the oceans
    e. The influence of the oceans on art, history and culture

  2. Teaching materials

    a. Materials of the Crustal Evolution Education Project
    b. Materials developed by agencies such as National Oceanic and Atmospheric Adminstration, Project ORCA and Project COAST
    c. Audio visual materials

B. The Great Lakes

  1. Information

    a. Origin of the Lakes
    b. Characteristics of the lakes
    c. Effects on the lakes on history and culture of the area
    d. Economic importance of the lakes

  2. Materials

    a. Materials developed by Michigan and Minnesota Sea Grant
    b. Selected materials of Ohio Sea Grant
    c. Audio visual materials

C. Lake Erie and Ohio Rivers

  1. Information

    a. Lake Erie

      1. Its development and characteristics
      2. Its effect upon the State's history
      3. Its economic importance

    b. The Ohio River and Its Tributaries

      1. Origin and characteristics
      2. Their Uses

  2. Materials

    a. Teaching materials developed by Ohio Sea Grant
    b. Other teaching materials

Text Materials

Ohio Department of Education, "Marine and Aquatic Education," Environmental Education Occasional Paper #6, August, 1981.

Ohio Sea Grant, Oceanic Education Activities for Great Lakes Schools, a series of 23 activities and teachers' guides containing background information on various topics and teaching strategies.

Selected articles from current literature.

References

Lafferty, Michael B., editor. Ohio's Natural Heritage, The Ohio Academy of Science, Columbus, 1979.

Goodwin, Harold L. Americans and the World of Water. University of Delaware Sea Grant Program, Newark, 1977.

Evaluation will be based on

1. Attendance and participation	70%
2. Completion of an activity	30%

ED 727P01
Schedule of Classes
Spring 1983

Date	Topic	Activities	Assignment
3/29	Overview of Marine and Aquatic Education	Slide presentation	Environmental Education #6
	Introduction to Sea Grant	Film	
	Geography of the Great Lakes	EP-14	
4/5	Effect of large water bodies on weather and climate	EP-1	EP-2 "Lake Erie and the Islands" 215-223
	Water level change in Lake Erie	EP-16	EP-5
4/12	No Class		
4/19	Origin of the Great Lakes	Film EP-3	Project Paragraph EP-6
	Formation of Ocean Basins	CEEP	EP-7 EP-10
4/26	Life in Sea and Lakes	EP-11	EP-19
	Economics of fisheries	discussion	EP-9
	The great whales	ORCA	"Life of the Lake & Islands" 224-235
5/3	Problems of oceans and Lakes		EP-8
	Polution	EP-23	EP-12
	Acid rain	Minnesota S.G.	"State of the Lakes"
	Sea lamprey	Michigan S.G.	
5/10	Impact of the seas on cultural heritage	Film songs	EP-18 "Images for a Sea People"
	music	Discussion	
	arts		
	language		
5/17	The Rule of Lake Erie in the Nation's History	EP-21 slide presentation	EP-15
	Shipping on the Lakes and oceans	EP-17 EP-20	EP-13
5/21	Field trip-Cleveland Lake front		
5/24	Law of the Sea	EP-22	
	Whaling	slide presentation ORCA	
5/31	Marine Resources	slide presentation	EP-4
	Seafood Smorgasboard	meal	

SUGGESTED ACTIVITY FORMAT

1. Title
2. Instructional Goal: the main concept or idea.
3. Objective: the behaviors the students should achieve.
4. Introduction: reasons why students should do the activity; interest grabber.
5. Procedures: steps the students perform in order to accomplish the objectives.
6. Evaluation: how the students will be evaluated; did the students achieve the objectives?
7. Resources and References: for students and teachers.
8. Extensions: additional assignments and enrichment activities (optional).

DEADLINES

April 19: a paragraph summarizing your activity and appropriate grade level.

May 31: completed activity due

SUGGESTED TOPICS

1. Water Sports
2. Legends of the Sea
3. Sea and River Paintings
4. Literature of the Sea and Rivers
5. Songs of the Sea
6. Human Life Under the Sea
7. Problems in Uses of the Coastal Zone
8. Life in the Sea and Rivers
9. Transportation on Seas and Rivers
10. Sea Battles; Lake Battles
11. Uses of Water
12. Types of Ships and Ship Building
13. How Seas and/or Lakes were Formed
14. Sea and Lakes as Energy Resources
15. Settlements along Coasts and Rivers
16. Others by request

APPENDIX I

1979-80 Student Survey Results

Manuscript accepted for publication in
The Ohio Journal of Science, February 1983.

OHIO STUDENTS' KNOWLEDGE AND ATTITUDES ABOUT THE OCEANS AND GREAT LAKES

ROSANNE W. FORTNER, School of Natural Resources, The Ohio State University, Columbus, Ohio 43210

VICTOR J. MAYER, Science and Mathematics Education, The Ohio State University, Columbus, Ohio 43210

ABSTRACT. A program to develop instructional materials for implementing marine and aquatic education in Ohio middle schools was begun by Ohio Sea Grant in 1977. This was followed three years later by a grant to disseminate the materials to schools in Ohio. To determine the effectiveness of the dissemination process a baseline study was conducted in the autumn of 1980. The survey obtained information on attitudes and knowledge of the Great Lakes and oceans from fifth and ninth grade students in randomly selected schools within three arbitrarily determined zones, the lake region, the central region and the Ohio River region. In addition students responded to items to determine their perceptions of the sources of their knowledge.

Students exhibited low levels of knowledge of marine and aquatic topics, with the poorest performance in those topics related to the humanities. The ninth graders scored significantly higher on all topics. Knowledge scores were related to attitudes and high scorers had more positive attitudes than low scorers. Students in the lake region did not have appreciably more water related experiences than those students in the other two regions. In both grades television was rated the most important source of aquatic information.

A similar survey will be conducted in the autumn of 1983 when the dissemination project will be completed. Any changes in ninth graders' knowledge and attitudes can in part be attributed to the program, provided fifth graders' behaviors have not changed appreciably.

AUTHORS' NOTE: This study was supported by Ohio Sea Grant through funding from the National Oceanic and Atmospheric Administration.

INTRODUCTION

The Office of Sea Grant, within the National Oceanic and Atmospheric Administration, supported a study resulting in a paper published in 1978 on the need for marine and aquatic education in the nation's schools (Goodwin and Schaat, 1978). The paper provided a definition of marine and aquatic education as a component of environmental education. The consensus of those contributing to the study was that since Earth Day, environmental concerns have resulted in an increased awareness of our air quality, mineral resources, drinking water and landscape, but too often the critical role of the oceans has been ignored.

What do our children know about the world's oceans? What are their attitudes toward them? THese questions must be answered for educators to be able to support the need for programs in marine and aquatic education and to effectively design such programs. Fortner and Teates (1980) conducted a study of children in Virginia, a coastal state, and concluded that ". . . some improvement in the level of student knowledge about the ocean is desirable, and specific ocean study courses have not been shown to be significantly related to marine knowledge or attitudes. Given this information, it is recommended that subject matter dealing with the ocean be infused into existing curricula. . ."

The Office of Sea Grant funded Ohio Sea Grant in 1977 to develop teaching materials for students in grades five through nine of Ohio's schools. The need for this development project was in part based on the results of a survey conducted by Howe and Price (1976). The survey was completed by about 30 students from each tenth and each twelfth grade class in 40 selected Ohio high schools. While results differed within and between schools, the data indicated that most students had positive attitudes regarding the oceans, recognized the importance of the oceans in the future of the United States, and were aware of related environmental problems. On the other hand, most lacked factual and conceptual knowledge about the oceans and other bodies of water.

In designing the development project, Ohio Sea Grant Staff felt that high quality teaching materials, focusing on factual and conceptual information about the oceans and the Great Lakes, would be a first step in facilitating increased learning among Ohio's school children about the marine and aquatic environments. Consistent with the recommendations of Fortner and Teates (1980) the materials developed were to be supplementary, two to five day modules, and infused into existing curricula. Because of the structure of Ohio schools, it was felt that this could best be accommodated at the middle school or junior high school level. The modules were collectively titled Oceanic Education Activities for Great Lakes Schools (OEAGLS).

None of the studies previously cited dealt with documenting student background in marine and aquatic education during the middle school years, nor did they attempt to determine changes in such knowledge and attitudes over a period of time.

The present study was designed to answer the following questions: (1) What do Ohio fifth grade and ninth grade children know about the oceans and the Great Lakes? (2) How does their knowledge change over the intervening four years of schooling? (3) What are the attitudes of Ohio fifth and ninth graders toward the oceans and toward Lake Erie? (4) How do these attitudes change over the intervening four years of schooling? (5) What do children perceive as their sources of knowledge regarding the oceans and the Great Lakes? (6) Do these perceptions change over the intervening four years? Fortner and Teates (1980) found that students who lived in close proximity to the coast had higher knowledge scores. A further question to be answered in the Ohio survey was whether this "proximity effect" was found also in relation to the Lake Erie shoreline.

Survey Development

Each of the survey instruments consisted of three parts: a knowledge component, an attitude assessment, and an experience inventory. A pool of 86 knowledge items was developed from those used in the earlier Ohio study, the Fortner and Teates (1980) study in Virginia and a study conducted by Delaware Sea Grant (Leek, 1980). Additional items were developed by staff of the Ohio Sea Grant OEAGLS project. The entire pool was reviewed by a panel of twelve experts in marine history, fisheries, and geography. Items were revised based on the experts' suggestions. The pool was divided into four tests and administered to 55 fifth grade students and 80 ninth grade students from a suburban Columbus school system. Students were asked to make comments on each item relating to the language used and its difficulty. In addition, a random sample of fifth graders was selected and interviewed about items. Teachers were also asked to comment on each item. These informal comments were used to modify items to make them understandable to fifth graders. In addition, item analyses were performed on each of the four pilot versions of the survey. A final item pool of 63 items survived the pilot procedures. These items were divided among three forms. Six items were selected as a core and were included on all three forms. These items were of a broad, general nature and appeared to be of greater significance than most of the other items. The remaining 57 were categorized by content area and then equally assigned from among the three areas of science, social studies, and humanities to each of the three forms, making a total of 25 knowledge items on each.

The semantic differential format was selected for the assessment of attitudes. Two referent concepts were used, "The Oceans" and "Lake Erie". Ten adjectival pairs were selected for use with the two concepts. The pairs represented the three dimensions of potency, evaluation, and activity. A panel of six individuals critiqued the scale and minor revisions were made. The third component of the survey was a series of items to determine student perceptions of their sources of knowledge regarding the oceans and the Great Lakes. The items developed by Fortner and Teates (1980) were slightly modified and used with this survey. The same attitude items and experience items were used on each of the three forms.

Additional information about each school's geographic and economic setting and about the class in which the survey was conducted was obtained through a questionnaire completed by the teacher. This information was used to verify whether instructions were followed in the selection of classes. It also provided data on the socio-economic status of the groups involved in this survey.

Design of the Study

In identifying the sample for the study, the State of Ohio was split into three regions. Those counties located within 50 miles of the Lake Erie shore comprised the "lake region," those within fifty miles of the Ohio River, the "river region," and the remaining counties, the "central region". Two lists were compiled by region, one with schools having fifth grade classes, and one with schools having ninth grade classes. A four percent random sample of the fifth grade schools was selected in each region. Since there are fewer ninth grade schools because of their generally larger size, a ten percent random sample was chosen from these schools. This resulted in a sample of 120 fifth grade schools and 110 ninth grade schools. A letter was sent to the principal of each of the selected schools explaining the nature of the study and offering an invitation to participate. Each principal was asked to list the teachers in the school at the fifth or ninth grade level in alphabetical order and to select the teacher at the middle of the list to be the administrator of the test. THe teacher's name was then sent to the investigators. The survey materials were sent to that teacher with a request to use them in the teacher's last class of the day and on or before a certain date.

Each teacher received sufficient survey forms for a class of students. They were sequentially arranged by form within the set received by the teacher, so that a third of the students in each class received form A, a third form B, and the remainder received form C.

Results were received from 79 of the originally selected fifth grade schools, a 66 percent response, and from 68 of the originally selected ninth grade schools, a 62 percent response. Totals of 1887 fifth grade students and 1786 ninth grade students participated in the survey.

The proportion of non-responding schools was relatively high despite the fact that intensive efforts were mounted to obtain responses from the original sample. Original response rates varied between a low of 59.0 percent from ninth grade river schools to a high of 84.6 percent from fifth grade central schools. It appeared that respondents differed in some respects from non-respondents. For example, it was more likely that non-respondent schools were from urban areas. This was particularly true of the river region. One factor was the strike of Cincinnati teachers which occurred during the testing period. Some caution must be exercised, therefore, in generalizing the results of the study, especially those from the river region.

Analysis of Data

Description of the Sample. Table 1 indicates the number of participating schools representing each community type and whether the funding source was public or private. Most of the schools in both grades were public schools. All types of community settings were well represented in the samples for each grade, although the proportions of schools in each setting varied between grade level and area.

TABLE 1 HERE

Among the responding teachers, about 60% of the ninth grade teachers indicated that they complied with the request to give the survey in their last class period within the range of dates allowed. Determination of the time of day used by most of the fifth grade teachers could not be made since most had self-contained classes. In approximately 14% of ninth grade classes teachers or principals noted that the survey was given in the class in which it could best serve as a learning experience to supplement the curriculum. Most apparently saw this experience to be related to science, and accordingly the most commonly reported subject area for survey administration was the science class (76% of ninth grade).

Five non-white racial categories were represented among students tested. Eighty-two percent of the non-white fifth graders and 90% of the non-white ninth graders were black. Because of the predominance of one race, the five categories were collapsed for analysis into a single non-white category.

Equivalence of Sample Groups. Since response to the survey was divided over three forms of the knowledge test and therefore obtained from three different groups of students, it was necessary to assure the equivalence of the groups in order to combine results across test forms. The Crosstabs analysis of the Statistical Package for the Social Sciences (SPSS) was used to generate a chi-square analysis of response frequencies by grade on the six items common to Forms A, B, and C. No significant differences occurred (p .05) between the means of the six items on the three forms, confirming the equivalence of the three groups.

Knowledge Scores. The Item Analysis program of the Statistical Analysis System (SAS) was used to tabulate response frequencies for each knowledge item by grade by region, and to produce total test statistics. Since the items varied greatly in their content, subtest scores were calculated for the three subject areas of science, social studies and humanities. The KR-20 reliabilities for the fifth grade respondents on the three versions of the test ranged from 0.35 to 0.47. Because of the low reliabilities no analysis of the fifth grade data beyond means and standard deviations were performed. For ninth grade respondents the reliabilities ranged from 0.56 to 0.69.

Attitude Analysis. A panel of reviewers was selected from among individuals involved in marine education in formal K-16 settings and informal education programs. Panel members were asked to indicate what they considered to be the most positive response to each item. The items were then recoded for analysis so that "positive" would always be at the high end of the scale of possible responses. Descriptive statistics were calculated for each item and for total attitudes about Lake Erie and the ocean.

Experience Profile. The first thirty-two questions in the Experience portion of the survey dealt with the wide range of experiences thought to influence knowledge or attitudes about water environments. Frequencies and means were calculated by region for the individual items to determine whether proximity to water was related to the frequency of each experience. A stepwise multiple regression analysis was conducted to determine whether any of the experience variables could serve as predictors for knowledge scores. For those that appeared to be related, Tukey's test of the mean was applied to assess the direction and strength of the relationship.

The final item in the experience profile asked for the type of information source students felt was most important in teaching them about the oceans and Great Lakes. Student choices of information sources were compared by region, race, sex, knowledge score and attitude mean using Pearson's correlation. This series of correlations was designed to indicate first whether students with different demographic characteristics were utilizing different information sources, and second, which source was related to higher knowledge scores and more positive attitudes.

Other Relationships An analysis of variance indicated the significance of differences among knowledge scores according to region, race and sex of respondents. Pearson's product-moment correlation was used to determine whether there was a relationship between knowledge scores and attitudes. This process was repeated for high scorers (X 67%) and low scorers (X 33%).

Results

Fifth graders answered 38% of the questions about the oceans and Great Lakes correctly, and ninth graders answered 48% correctly (Table 2). When sub-test scores were calculated, it was found that ninth graders' knowledge of aquatic concepts in social studies is about the same as that in science, about 50% correct. Knowledge of water related humanities concepts, however, is considerably lower (41%). Among fifth graders, the highest scores were made on the science subtest (41%) and the lowest on humanities (32%).

TABLE 2 HERE

Knowledge scores were shown to be significantly related to attitudes (p .001) and the data in Table 3 illustrate that high scorers have more positive attitudes than low scorers.

When specific attitude items were examined in relation to knowledge scores, it was found that those who scored higher were also those who felt that Lake Erie and the Ocean were important and valuable. Overall, attitudes toward the ocean were more positive than those toward Lake Erie, even among residents of the Lake Region.

TABLE 3 HERE

An analysis of variance was performed to identify relationships between demographic factors and knowledge scores. Main effects were significant (p .001) for region and race in Grade 5 and for region, race and sex in Grade 9. Specifically, white students in coastal areas scored higher in both grades. In the ninth grade, males outscored females. For the ninth grade there was also evidence of an interaction between region and sex (p .05) such that regional differences occurred primarily among males.

Students in the Lake region did not appear to have appreciably more experience with water related activities than the River or Central groups. Fifth graders generally reported lower frequencies of such activities except for those that involved reading books or magazines. The fifth graders also expressed a greater interest in learning more about the oceans and Great Lakes. Question thirty-three of the experience inventory collapsed the preceding items into five categories. Responses on this item by grade are reported as Figure 1. In both grades the category of movies and television was selected most frequently as being the most important source of information about the oceans and Great Lakes. Classroom experiences were more frequently chosen by fifth graders, as were non-formal institutions of learning such as museums. It is interesting to note that the fifth graders, though they claimed to have been frequent readers of magazines, did not select that category as a major knowledge source.

FIGURE 1 HERE

Because Fortner and Teates (1980) reported that three experiences were shown to have a particularly strong positive relationship to marine knowledge, the same three experiences, the number of Cousteau programs seen on television; frequency of reading *National Geographic*, and ability to swim, were examined in this study. For the ninth grade data a stepwise multiple regression analysis identified nearly the same variables, substituting *National Wildlife* as the magazine, as accounting collectively for thirteen percent of the variance in knowledge scores. Using Tukey's test it was found that knowledge scores were significantly higher with more experience in each of the activities.

Discussion

The students tested had low levels of knowledge regarding marine and aquatic topics. The magnitude of this problem is illustrated by the responses of students when asked to identify Lake Erie on an outline map of the Great Lakes. Only 60% of the ninth graders and 46% of the fifth graders correctly identified Lake Erie. Other questions indicated a lack of knowledge about the presence of PCBs in fish (29% correct in Grade 9), how much of the world's food comes from the ocean (40% correct) and where energy comes from for life in the sea (45% correct). These topics are among the basic concepts that Picker (1982) compiled as the experts' consensus on a "Conceptual Scheme for Aquatic Studies."

Others of those concepts fared well. In the ninth grade, 54% knew what plankton are, 65% chose ships as the cheapest transport method for certain routes, 75% were aware of reasons why marine fossils are found on some mountaintops, and 60% could identify the binding interest of OPEC countries. Such information is important as a basis for responsible decisions, and the levels of knowledge indicated are encouraging.

The poorest performance occurred on items related to humanities, indicating that students are not encountering, or at least not remembering, information on the seas' and lakes' importance in our culture. While such information is perhaps not as important in the building of informed decision makers as is the scientific, historic and economic value of waterways, exposure to the cultural aspects can be a life-enriching experience. Exposure to this information also helps in informing the student of the pervasive impact of the world of water in all aspects of human life and therefore can have implications in demonstrating the importance of decisions on water related politics.

That ninth graders scored significantly higher on knowledge than fifth graders may be cause for optimism. This study has demonstrated a correlation between higher knowledge and more positive attitudes about the importance and value of water systems. Formal and informal experiences over the four year period between the grades are apparently producing desirable changes in the school population. If we can identify which of those experiences are the most effective information sources, then their use can be maximized to improve knowledge about the world.

Thus, an important aspect of this report is a consideration of where the subjects' information might have originated. The largest percentage of the subjects felt they got their information from movies and television. The demographic factors shown to be related to knowledge scores were region and race in Grade 5, with sex also related in Grade 9. An opportunity factor may be involved in the regional "proximity effect," with more aquatic experiences available in the coastal region, and a historic factor of dominance by white males in water-related careers may also be related. Combining these possibilities with the additional related factors of watching Cousteau programs, reading National Wildlife and being able to swim, it is not difficult to surmise the influence of socioeconomic factors on aquatic knowledge. Better clues to socioeconomic influences would be measures of family income and education level which were not collected in this study but should be included in future research.

This study has served the Ohio Sea Grant Education Office as a baseline of marine and aquatic knowledge and attitudes, and therefore as a guide to what information should be provided in curriculum materials and/or teacher training. It has shown that water-related knowledge, attitudes and experiences in a Midwestern state are very similar to those in a coastal state such as Virginia. It has also suggested other mechanisms besides K-12 education as information vehicles, and has thus served as justification for projects involving radio and museums as dissemination media. Finally, the survey will be treated as a pretest which preceded a three-year program of teacher education in marine and Great Lakes education, grades 5-9. Repeating the survey in the 1983-84 school year, with a new sample chosen in the same way, should indicate whether this information has been passed on to the teachers' classes to the extent that ninth grade scores are substantially higher than the pretest scores. In the posttest the fifth grade will serve as a comparison group, since that grade level and below will be minimally impacted by the teacher education program and OEAGLS materials. In that regard, this study will serve as a summative evaluation for both projects.

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Table 1

Description of Responding Classes

	Grade 5			Grade 9		
	Lake	Central	River	Lake	Central	River
Number of Schools	30	22	27	28	17	23
Setting						
Urban	20.0%	18.2	22.2	14.3%	17.7	4.3
Suburban	30.0	18.2	18.5	32.1	17.6	26.1
Town (pop.100,000)	26.7	40.9	25.9	42.9	23.5	34.8
Rural	23.3	22.7	33.0	10.7	41.2	34.8
Funding						
Public	74%	83%	83%	81%	93%	91%
Private	26%	17%	17%	19%	7%	9%

Table 2

Knowledge of Oceans and Great Lakes for Total Test and by Knowledge Category

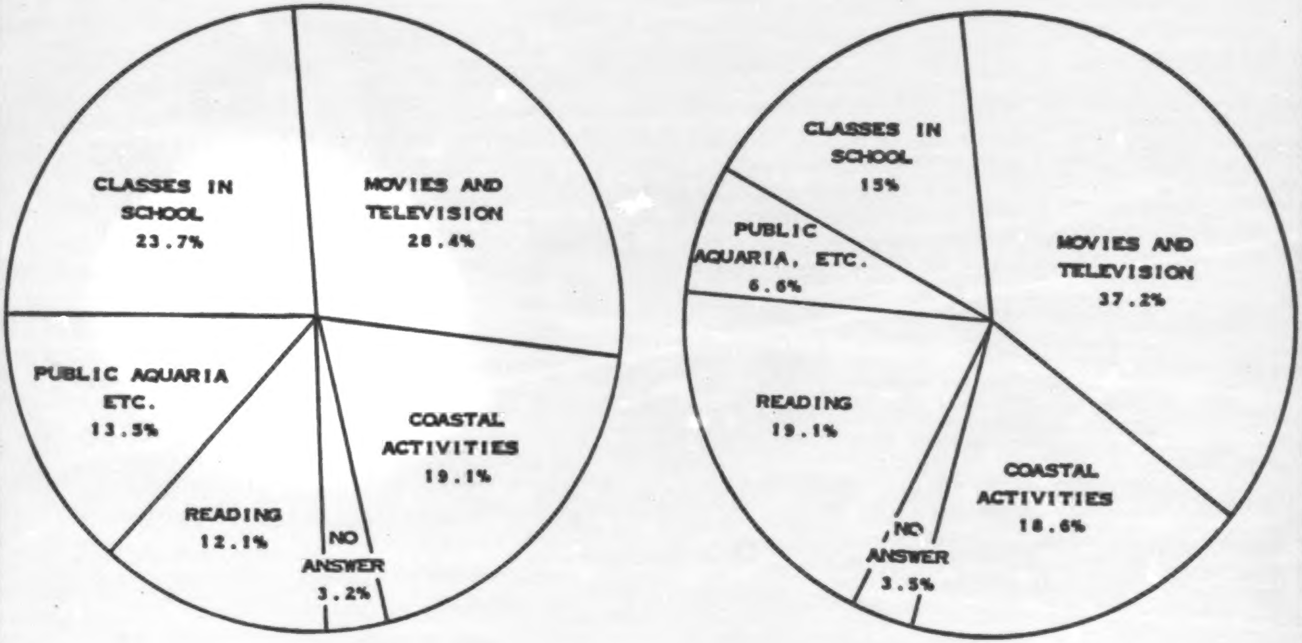
	Percent Correct	
	5th	9th
Total knowledge test	37.6	48.3
Science	41.0	50.6
Social Studies	36.8	50.0
Humanities	31.8	40.7

Table 3

Relationship of Marine and Aquatic Knowledge and Attitudes:* Attitude Means by Knowledge Level

Grade	All Students	High Scorers (x 67%)	Low Scorers (x 33%)
5	3.76	4.01	3.73
	N = 708	20	688
9	3.97	3.15	3.75
	N = 496	207	289
5	3.49	3.76	3.49
	N = 708	20	688
9	3.29	3.34	3.20
	N = 496	207	289

*Maximum positive attitude = 5.



FIFTH GRADE

NINTH GRADE

Figure 1: Perceived Influence of Experiences on Ocean and Great Lakes Awareness.